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EDUCATION

VOLUME 71 No. 7

EDUCATING FOR RESPONSIBLE CITIZENSHIP IN THE ATOMIC AGE

The Promise of Atomic Energy

Atomic Weapons and World Peace

The Social, Economic, and Political Implications of Atomic Energy

Educational Implications of the Atomic Age

Emotional Stability of Children in the Atomic Age

I Taught Atomic Energy

We Studied Atomic Energy

The Social Science of Atomic Energy
A Course Proposal at the College Level

A MAGAZINE DEVOTED *to the* SCIENCE, ART, PHILOSOPHY *and* LITERATURE *of* EDUCATION

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BERNICE D. BURNETT and R. WILL BURNETT, *Editors*

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EDUCATION

Vol. 71 MARCH 1951 No. 7

The Promise *of* Atomic Energy

By SUMNER T. PIKE

Member, United States Atomic Energy Commission

THE word "promise" conveys hope and expectation and it has a distinct though inexact association with the future. But to a considerable degree within five short years the promise of atomic energy has turned into actuality. By-products of the atomic pile are used routinely—treatment of choice as the doctors say—in medical diagnosis and treatment. These materials have revolutionized research and have found practical uses in agriculture and industry. "The most important development in science since the invention of the microscope," says one scientist. "Man's greatest boon since fire," writes another. "With these materials, we have learned more about the action of fertilizers in three years than we had by other methods in the previous fifty," reports a leading fertilizer scientist in the Department of Agriculture.

The unusual materials which draw this high praise are called radioisotopes. They are most simply described as radioactive forms of ordinary elements like carbon, iron or sodium. Each radioactive atom contains excess energy and soon or later the atom breaks down releasing its energy as radiation and relapsing into a stable form, perhaps of a different element altogether.

The release of energy is the important thing to bear in mind. In some applications the energy itself is used. For example, radiation will kill animal and plant cells, and hence some radioisotopes may be used to destroy cancer. But the energy will also kill normal cells so that radioisotopes are dangerous and must be handled carefully by experts trained in their use.

Because their radiation can be detected with Geiger counters, radioisotopes can be followed through the body of an animal or a chemical plant. The most complex processes can be analyzed by substituting "hot" elements for normal ones and tracing them through invisible and complex reactions. Incredibly small quantities can be traced, in some cases less than a trillionth of an ounce. No other analytical method approaches radioisotopes in sensitivity.

Many radioisotopes appear in nature. All living things, for example, contain radiocarbon, called carbon 14 because each atom weighs two units more than an atom of ordinary stable carbon 12. Carbon 14 is constantly produced in nature by the cosmic ray bombardment of nitrogen. Living plants and in turn animals that live on plants absorb this material. At death the process stops and the radio-

carbon slowly decays over thousands of years. As the radiocarbon decays the ratio of radiocarbon to ordinary carbon changes and so scientists can determine when the plant died.

By measuring the carbon 14 content in Indian relics found in New York state, archaeologists discovered last year that Indians had lived there for 5,000 years, over twice as long as they had previously thought. This radiocarbon clock has dated hundreds of prehistoric objects, going back 25,000 years, from Egyptian mummies to the camp fires of cliff-dwellers.

Most research, however, is conducted with artificial isotopes, and particularly those produced in the atomic pile at the Oak Ridge National Laboratory, Tennessee. Since 1946 more than 16,000 shipments have left Oak Ridge. Almost half of these shipments were for radioiodine and radiophosphorus for treating diseases. Over 500 shipments were made for industry and industrial research.

In medicine, isotope uses fall into two classes: (1) treating disease, and (2) medical research. Certain elements have a strong affinity for specific parts of the body. When iodine enters the body, it accumulates within seconds in the thyroid gland. Suppose, now, that in disorders of the thyroid, iodine could be made to carry along the means for treating the disorder. Radioactive iodine does just this. The radiation released in the decay of radioiodine destroys thyroid tissue, and in certain types of cancer of the thyroid the cancer tissue is destroyed too. In certain diseases, such as hyperthyroidism, marked by over activity of the thyroid, radioiodine has proved a satisfactory form of treatment.

Phosphorus, when first taken into the body, concentrates in the blood-producing centers—the bone marrow, spleen and lymph glands. In view of this affinity, radiophosphorus has proved effective in treating some blood disorders, notably polycythemia, a disorder in which there is over-production of red corpuscles.

Aside from surgery, radiation from radium or X-ray has proved the only successful cure for cancer. To these radiocobalt from the Oak Ridge pile has now been added. Radiocobalt is a uniform source of radiation, equivalent to an X-ray machine of about 2 million volts. It is much less costly than radium and is available in units of greater activity. It is, in many applications, more flexible than radium, particularly since cobalt can be shaped into needles, beads or other forms before it is made radioactive in the pile. Up until now, however, when the malignant growth is inaccessible from outside the body, radiocobalt, like radium, cannot be used.

The most ambitious project for using radiocobalt is being undertaken by radiologists at Anderson Hospital, Houston, and at the Medical School of the University of Texas in cooperation with the Oak Ridge Institute of Nuclear Studies. These experts are designing a radiocobalt "bomb" which will have radiation equivalent to roughly 1000 grams or $20,000,000 worth of radium.

The problem in treating deep-seated cancers by radiation is two-fold. First, there is the problem of locating the growth, and second, there is the problems of getting the radiation to the cancer without destroying the intervening tissue. Radioisotopes promise to assist the physician in both problems.

Radiologists at Memorial Hospital, New York, have developed an ingenious device for internal application of radiation. Instead of using a single powerful beam of radiation, the equipment will be so designed that a large number of killing rays will enter over a wide area of the body and be focussed at the site of the malignancy within. In this way the intervening tissue will receive only a fraction of the dose that is given the cancer.

The problem of locating cancer is being attacked in another way. Cancer and tumor tissue grows very rapidly, much more so than the surrounding normal tissue. All growing tissue requires special building materials—for example, phosphorus, and the cancer tissue utilizes phosphorus more rapidly than normal tissue. By using radiophosphorus the physician can locate and differentiate the rapidly growing areas and thus separate the diseased from the healthy tissue. While suggestive of how the technique can be done, the use of phosphorus for this purpose has not been entirely successful. A radioactive fluorescein dye, however, is used with considerable success in locating and marking out brain tumors to guide the surgeon in removing the diseased tissue.

But to date the medical doctors have barely scratched the surface in their use of radioisotopes. Altogether there are more than 700 species of radioactive materials, each having its own characteristic type of radiation. In some cases the rays will be stopped by a sheet of tissue paper; in others radiation will penetrate clear through the body and pass through several inches of lead. Only a few in this extraordinary range of materials have been tested. An applicator containing radiostrontium has been successful in treating the eye disease, keratitis. The low energy radiation from radiograllium appears useful in treatment of skin cancer. Radiogold is suspended in solution and injected directly into cancerous masses near the surface of the body. This radiation rapidly decays so that a measured dosage can be given and the material left without burning healthy tissue nearby.

But regardless of how useful radioisotopes may prove in actually treating diseases, there seems little doubt that the great benefits in medicine and for that matter biology, animal husbandry, agriculture and all other sciences dealing with living things will come about through new research methods made possible with their use.

Strangely enough one of the first of nature's secrets to be learned with radioisotopes explained why radioisotopes were to become so important in the study of living things. Only when we could begin to trace biological processes with these new materials did we really begin to learn how extraordinarily complicated they were and how rapidly such processes were carried on.

Take photosynthesis, for example. In this process, perhaps the most basic of all life processes, the plant uses energy of sunlight to turn water and carbon dioxide into energy-packed carbohydrates. In tracing the steps of this complex process scientists at the University of California place a plant or part of a plant in an atmosphere of radioactive carbon dioxide and light. The plant is then broken down into its component parts. Those parts containing radioactivity are the ones formed in the early stages of photosynthesis. The process must be stopped almost immediately, within 5

seconds or so, or the work is wasted. It proceeds so rapidly that within 60 seconds the radioactivity may be found in almost all the components.

With tracer isotopes, biological scientists are able to tag substances introduced into the body and follow them wherever they go.

How does the body use amino acids? They have been tagged with radioactive sulfur, fed to rats, and then traced to the tissues to which they travel. Their utilization in healthy rats has been compared with that in diseased rats. Bone, blood and organic tissues have been analyzed to find what form the sulfur has taken, how much has been used in proteins, how much has not combined, and so on.

How does the body use iron? Radioiron fed to dogs reveals that unlike most elements used by the body iron is used again and again. Incorporated primarily in the red cells, as the old cells die the iron is re-used in forming new cells. Only small quantities of iron will normally be absorbed from the food.

Mosquito larvae reared in a radiophosphorus solution remain radioactive all their adult life. By using small test groups of tagged mosquitoes, public health workers are learning how long mosquitoes live and where and how far they travel.

Radioactive sodium injected in the blood stream will measure the rate of circulation. Foxglove plants grown in an atmosphere tagged with radiocarbon will yield radioactive digitalis, which may in turn be given to animals to study its effect on heart action.

The great value of radioisotopes in agriculture has been found in plant-growth studies in which scientists can determine exactly how various chemicals are taken up and used by growing plants. They are particularly valuable for study of trace elements—molybdenum, zinc and cobalt—which plants and animals seem to need in minute amounts and without which they sicken and die.

Radioactive materials have been used to solve problems that have industrial significance for 30 years or longer. In 1920, Dr. Georg von Hevesy of Sweden, the first worker to recognize how radioisotopes might serve as tracer materials, used radiolead, one of the natural decay products of radium, to demonstrate self-diffusion in molten lead. A layer of lead containing the radioactive material was placed at the bottom of a tube and a layer of ordinary lead was placed over it. The lead was melted and held at a constant temperature for several days. After the material was cooled, the migration of the radioactive material could be detected by measuring the alpha radiation at various positions on a thin cross-section.

The rate of diffusion in solids, especially metals, is usually so slow under normal conditions that the tracer technique is the only one sufficiently sensitive to give reliable results in a reasonably short length of time. It is the only method capable of measuring self-diffusion.

The procedure is simple. One surface of a metal block is plated with a thin layer of a radioactive isotope of the element under study. The surface radioactivity is then counted. The sample is subjected to heat or other conditions suspected of causing diffusion and it is counted again. The loss in surface activity is directly proportional to the amount of diffusion taking place.

A most fruitful use of the tracer technique is measurement of the small amount of material removed from surfaces during friction wear. Wear of machine parts during actual operating conditions can be studied. Knowledge of piston ring wear not only leads to improved engine performance but increased lubricant efficiency.

For such studies the parts may be made radioactive either by plating with radiomaterial or by irradiating them in a nuclear reactor. Although a month's irradiation of piston rings in the reactor at Oak Ridge causes less than one in a billion of the iron atoms to become radioactive, the counting equipment is sufficiently sensitive to measure even an extremely small amount of this iron.

Next, there is the type of material transfer caused by physical-chemical action—such phenomena as adsorption and absorption, surface wetting, solubility, and iron-exchange. These are important in industrial processes widely divergent as the action of detergents and preservatives and the flotation of ores.

For example, radiocalcium has been used by one large chemical corporation to study the action of detergents in hard water. Artificial hard water was made by adding radioactive calcium to wash and rinse waters in the form of labelled calcium bicarbonate. Swatches of cotton cloth were washed in the labeled water in the presence of various types of detergents and the dried swatches were counted for radiocalcium uptake. The lower the amount of calcium remaining on the fibers, the better the detergent action.

Perhaps the most fascinating uses of radioisotopes as tools of industrial research is in studying the mechanisms of chemical reactions—oxidation of hydrocarbons, polymerization and vulcanization of rubber, hydrogenation of petroleum. A striking example is the use of radiocarbon 14 in studying the mechanism of the Fischer-Tropsch synthesis, for getting gasoline and diesel oil from coal or natural gas.

In a recent survey one of the country's leading metallurgists pointed to three general classes of metallurgical problems which can be solved by radioisotopes.

1. Experiments of a fundamental or theoretical nature such as the diffusion problems mentioned above or exchange reactions.

2. Experiments for working out processes and process control studies.

3. Use of isotopes in analytical procedures. Frequently with radioisotopes an accurate and inexpensive analysis of constituents in metallurgical processes can be made while the process is going on. Purification of the steel can be followed right at the furnace by simply adding small quantities of radioisotopes of the same elements that are found as impurities. As the impurities, say phosphorus or sulphur, go into the slag, the percentage of the element in question can be determined by the measurement of the radioactivity of samples taken at various intervals.

A series of papers on the use of radioisotopes in the pharmaceutical industry has been recently published. In order to encompass the wealth of material into an orderly presentation the authors discussed the subject under a total of 17 different topics, ranging from localization of tumors and other diagnostic aids to drug metabolism.

The head of the ceramics department at a large midwestern university

suggests that there are hundreds of problems in the ceramics and glass industries which radioactive tracer techniques will solve. And so it goes in industry after industry.

These examples which could run on endlessly represent thousands of reports on radioisotopes written by investigators throughout the world. Their very number and variety defy generalization, but in summary we can say that radioisotopes provide a new way of seeing nature and of learning her secrets. They give the most penetrating, exciting, close-up of reality that we have ever had. Here and now we can only dimly foresee their ultimate impact upon our lives. It will be very great indeed.

While research stimulated by the atomic energy program may eventually be more significant than any other part of the program, the possibility for cheap, abundant power from the atom has captured the imagination of the public.

President Truman gave recognition to this fact in his 1950 State of the Union Message to Congress. He said:

"In the peaceful development of atomic energy, we stand on the threshhold of new wonders. The first experimental machines for producing useful power from atomic energy are now under construction. We have made only the first beginnings in this field, but in the perspective of history they may loom larger than the first airplane, or even the first tools that started man on the road to civilization."

The scientists and engineers have no doubt that these experimental machines will produce power. But the extent to which atomic energy will supplant or supplement present power sources and when depends upon two main categories of problems—technical and economic.

The technical problems involved are many and have frequently been described. For example, there are the problems of:

Materials to stand higher temperature than are attainable from chemical reactions, materials which show minimum radiation damage under the intense bombardment of neutrons, gamma-rays, etc., in the interior of the reactor, and materials which do not absorb and waste an excessive proportion of the available neutrons.

Shielding of personnel and instruments against the adverse effects of radiation.

Heat transfer rates higher by an order of magnitude than those conventionally used.

The handling and ultimate disposal of radioactive wastes in a manner which will constitute the minimum health hazard.

The difficulties involved in these problems have often been stressed. The important point, however, is that it is with precisely these problems that our huge national laboratories have been preoccupied since 1945. Much progress has been made toward solution but, as in other applied research programs, just how much is difficult to assess without some full scale trials.

The technicians are confident that in one way or another, through perseverence and stubborn hard work the technical problems in the way of atomic power plants will be solved. There remain the economic problems. To justify building an expensive reactor (small ones range up to $5 million; full-grown ones from $25 to $50 million) there should be a demon-

strable need. To assess the need we must know the costs, but costs can only be determined by first building reactors. To break out of this vicious circle the Atomic Energy Commission has been favored by the fact that for military needs the unknown economic factor is less stringent.

The expanding atomic energy program is designed to process as rapidly as possible all available source materials into fissionable materials which may be used either for weapons or for power. This requires that power reactors must at least partially replenish or replace the fissionable material used up. Mobile military reactors for submarines or aircraft therefore converge on production reactors, and both should eventually be combined with breeding of new fuel. Because of their need for the lowest possible cost of power, civilian power reactors must interlock with production processes and therefore production reactors for military uses.

Thus dual purpose reactors to produce both power and plutonium appear to be the most feasible next step in reactor development. Much of the operating cost could be charged off to the production of plutonium so that power might be provided at reasonable costs.

At this point in time it is too early to tell whether this particular approach to civilian power will work out. It is encouraging to note, however, that within recent weeks several private industrial groups have expressed great interest in the prospects and they are eager to begin serious studies of the proposal.

The fact remains that nuclear fuel provides our most concentrated source of energy. The heat released from a single pound of fissionable uranium equals that of 1300 tons of coal. We can rest assured that neither scientist, engineer, nor ordinary citizen will be content until atomic energy goes to work.

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Atomic Weapons *and* World Peace

By AMBASSADOR WARREN R. AUSTIN
United States Representative to the United Nations

THE unlocking of the atom was an achievement of education. It was the product of pure science. It opens up unpredictable vistas of new development in man's control of his environment and the improvement of his existence.

Science did not set out to invent atomic weapons. In the pursuit of knowledge scientists of many countries, particularly in Western Europe, investigated over a long period the structure of matter and energy.

Decades before, the findings of pure science opened the way for the controlled release of energy in various forms. The applications of these findings resulted in the development of steam power, electric power, the combustion engine and the like.

And each new finding of pure science had some important application in the creation of new weapons which increased fire-power and mobility in warfare. With each increase in the power to devastate and destroy there was a parallel increase in the power to produce and build.

While wars are fought with weapons, weapons do not start wars. If a nation has to fight, it naturally draws upon science and technology to the utmost to produce the most efficient weapons. The technically advanced nation has a marked advantage in war over the technically retarded nation primarily in terms of its weapons and its capacity to produce them in quantity.

Wars are deadly serious contests involving the whole direction of civilizations. It is not surprising then that a nation or a group of nations engaged in a life-and-death struggle which is to determine the future of its way of life for generations does not pick its weapons on the basis of what will do the *least* damage to the enemy.

Responsible statesmen have recognized for a long time the truth of the declaration in the Preamble of the UNESCO Constitution: "Since wars begin in the minds of men, it is in the minds of men that the defenses of peace must be constructed." The prevention of war itself is the only effective safeguard against the use of destructive weapons. The outlawing of specific weapons by paper pledges is illusory.

The pre-war conventions prohibiting the use of poison gas did not stop the production of poison gas or the training in the use of it in battle. Rather it was the retaliatory power on both sides which inhibited the employment of the weapon. Saturation bombing was vastly more destructive, but this was not the subject of outlawry agreements.

As weapons have rapidly become more and more devastating, the pres-

sure for practical means of preventing war itself has increased. Thus the destructiveness of weapons has its effect on the struggle for world peace. The effect is on the minds of men, driving them to seek defenses of peace *in* the minds of men.

The atomic weapon seemed to offer a unique opportunity for building the defenses of peace in the minds of men. The Acheson-Lilienthal Report concluded that the only defense was a revolutionary offense against the impersonal enemies of mankind. The only practical way of preventing the use of atomic energy for destruction was to pool international efforts to develop this power for peaceful purposes. Such a world cooperative opened up exciting possibilities in two fundamental fields.

First, in the field of war-control it called for a kind of international inspection which would build the defenses of peace in the minds of men by reassuring people that no nation was preparing for an atomic attack. If this could be done for the atomic weapon, the principle could be applied stage by stage to all sorts of weapons and preparations for international conflict. In the very process of developing effective international controls and safeguards in terms of the unique characteristics of this unusual weapon, a kind of international collaboration would take place which would be a powerful defense of peace by reducing national fears and mutual suspicions.

Second, such a world cooperative on the positive side would unite scientists and technologists in an unprecedented attack on the impersonal enemies of mankind—disease, hunger, and poverty. The growing sense of security by preventing misuse of atomic energy would be matched by a growing sense of human fraternity in the act of developing and applying atomic energy for peaceful purposes.

In 1946 the United States took the initiative in putting before the United Nations the most daring proposal for international cooperation ever made by a great nation to the world community. With an absolute monopoly of a powerful weapon, the United States proposed to put it under the control of an international authority, to open is plants and laboratories to international inspectors, to participate in a great world cooperative for the development of atomic energy for peaceful purposes only.

Ever since that day, the Soviets have been trying to make the world believe that *they* took the initiative; that we refuse to outlaw the atomic weapon; that we, and not the Soviets, have obstructed the adoption of a United Nations plan for effective, enforceable control; that we are using atomic energy exclusively for weapons of destruction while they are using it for peaceful, constructive purposes.

With the world's largest standing army, a vast arsenal of big guns, tanks, planes, submarines, "block-buster" bombs, and secret weapons of mass destruction, the Soviet Union calls for the outlawing of the *one* weapon in which it is deficient, without submitting itself to effective international controls. By its deceptive plan, it not only seeks to eliminate this weapon from the arsenals of democracy, but to rig the arrangement so that the Soviet Union *could* attain atomic superiority under the guise of production for peaceful purposes.

The Soviets have tried to play a tragic hoax upon the peace-loving

people of the world. They have vetoed the United Nations atomic control plan, adopted by the General Assembly in 1948 by a vote of 46 to 6. The 6 negative votes were cast by the members of the Soviet bloc. The single veto which completely obstructs the further development and implementation of the plan was cast in the Security Council by the Soviet Union.

Their alternative plan seeks to outlaw the atomic weapon, destroy existing stocks, and then institute an undefined control system to prevent any nation from making atomic weapons, while leaving them free to produce atomic fuel for so-called "peaceful purposes" without international control. Those in a nutshell are the terms of the Soviet atomic hoax.

Under the leadership of the Soviet-directed world Communist movement, this hoax has been promoted as the so-called *"Stockholm Peace Petition."* By sly deceptions the promoters have roped in millions of unsuspecting people as signers of this trick peace petition. We know from careful checking that a high proportion of the signers did not even read the words. They were merely asked whether they wanted peace, and then invited to sign on the dotted line.

By adopting this petition, the Soviets try to make the world believe that they are ready to outlaw the atomic weapon and the United States stands alone in opposing oulawry. They are trying to make people believe that the Soviets are prepared to accept the "strict international control" called for in the petition.

I want to expose these two propositions.

First: we have taken the initiative *really* to outlaw the atomic weapon, and we stand united with the overwhelming majority of the nations of the world on a practical plan for doing just that. The Secretary of State made our position crystal clear in his address to the General Assembly on September 20, 1950.

He said: "My country reaffirms its support of the United Nations plan for the international control of atomic energy which would effectively prohibit atomic weapons." Could anything be more plain and explicit?

He goes on to say, "We will continue to give sympathetic consideration to any other proposals that would be *equally or more* effective in accomplishing this purpose." That means what it says—that we are not sticking to a particular formula—this or nothing—but we are prepared to consider *any* plan which will achieve the purpose.

Second: we will *not* match our honor with well-known duplicity in a fraudulent scheme that *appears* to prohibit atomic weapons without actually doing it. So far the Soviet Union has accepted the phrase "strict international control and inspection" with a trick interpretation. Let me expose that trick again.

They have refused to accept as the basis for a control plan the elementary fact of atomic science, namely, that the same atomic fuel that can be used for peaceful purposes can be converted to destructive ends on a moment's notice. Atomic fuel may some day be used to generate electric power. We do not know how to do it yet, but we are experimenting with the problem.

There are many non-dangerous activities in the application of atomic theory for constructive purposes. But whenever you are dealing with the

atomic fuel itself in critical quantities, you are inevitably dealing with a powerful explosive. It can be packaged in a simple bomb-container which can be made in any machine shop in short order.

So here is the trick interpretation of the Soviets for the phrase: "strict international control and inspection": the controls and inspection would apply *only* to the production of atomic weapons, *not* to atomic materials used for peaceful purposes. The inspection is merely designed to look into possible violations of the pledge not to make atomic weapons. And we have never been able to get from the Soviets a clear definition of how even that kind of inspection would work.

This, of course, is no control at all. It demands that the existing stock of atomic weapons be destroyed. In other words, the atomic fuel that is labelled "bombs" is destroyed. Then everybody starts from scratch to make atomic fuel for peaceful purposes only, and the international inspectors report if anybody starts putting this explosive stuff into bomb containers.

You can understand, then, that you have to know something about the facts in order to see through this hokum. It isn't enough to be for peace and want to outlaw the atomic weapon.

The Soviet Union would have us believe that it is making tremendous strides in developing atomic energy for peaceful purposes, but the iron curtain prevents us from knowing first-hand what the Soviets are doing. By their own claims, however, they expose their atomic hoax.

Mr. Vishinsky, at the 1949 General Assembly, said:

"Right now we are utilizing atomic energy for our economic needs in our own economic interests. We are razing mountains; we are irrigating deserts; we are cutting through the jungle and the tundra . . . We are doing this because we are the *masters* of our great land under our *own* plan, and are required to account for this to no international organ of control."

There it is, stated in Mr. Vishinsky's own words. The peaceful use he is talking about is bombing of mountains, impasses in the way of rivers, changing the earth's surface by atomic explosions. The scientific evidence is that they did produce an atomic explosion. Where precisely, or for what purpose, we do not know. The Soviets have not permitted any scientific authorities from the outside world to see what they did.

But Mr. Vishinsky has used the dramatic claims to make two things very plain. First, that the one peaceful use they have found for atomic energy is a gigantic explosion. Second, that they will not put *that* kind of bombing power under international control or inspection. By their own words, the Soviets insist on being the "masters," and will "account for this to *no* international organ of control."

The Soviet "no" to the hope of all people for real protection against misuse of atomic power and for unpredictable good uses resounds around the world.

This obstruction has not only prevented the building up of the defenses of peace in the minds of men, but it has been carried on with the aim of weakening and splintering the defenses the free world has and can build up against aggression. The Soviets have used the devices of psychological warfare in their concentrated attack on atomic weapons to sow confusion, in-

spire fear, and to break down the power of resistance to their aggressive designs.

While the non-Soviet world held a monopoly of atomic weapons and the Soviet Union had no effective defense against them, world peace was vitally affected by this single weapon. It had the effect of immobilizing both the physical and psychological power of the vast Soveit military machine. It bought time for the free world to learn the intentions and methods of Soviet imperialism, and to recover from the economic and social chaos produced by the Second World War.

The achievement of the Soviets in producing the atomic weapon immediately *began* to shift the balance from peace to war. The preponderance of atomic weapons is a relative matter; for beyond a certain point additional bombs count for less and less as deterrents to war. Of course, the atomic weapon is a dependent one, relying absolutely for its effectiveness on the capacity to deliver it to specific targets. With these two factors in mind—relative numbers and capacity to deliver—the point at which this kind of superiority ceases to be a real deterrent can be foreseen but not accurately predicted.

Meanwhile, the Soviets seek to neutralize this superiority by their psychogical warfare. In other words, they are attempting to undermine the defenses of peace in the minds of men outside the Iron Curtain. And this poses an educational problem of the first magnitude.

While the atomic weapon played a decisive role as a deterrent against aggression during the past five years, if we are not careful it may now play a decisive role as an obstacle to united resistance. The Stockholm Peace Appeal was cleverly designed to spread terror throughout the free world while at the same time putting the blame on *a weapon* and on *the nation* having a preponderance of power in that weapon.

The terror is struck into the hearts of virtually defenseless Europeans by the phrase, "the Russians have it too." The blame is put on us by the challenge to outlaw it under terms I have tried to show cannot be accepted. Thus by sheer propaganda the Soviets are seeking to isolate the free world from the United States so that they can bring each victim, dealing with the most vulnerable ones first, under the pressure of their military power. One by one they may be confronted with the choice of making concessions to the Soviets or risking unpredictable trouble. The main concession I think will deal with the defense plans of the prospective victim. The Soviet Union pretends that any increase of weapons and forces within a plan of collective security is threatening to it.

Coupled with the demands for concessions there will undoubtedly be promises of immunity in such terms as non-aggression pacts similar to those Hitler offered his victims in 1939. Whatever the concession is, it is likely to seem small compared to the alternative of resistance and the risk of an atomic war.

No one can know with certainty just how long the free world has in which to build up and unite its defensive strength behind the deterrent power of American atomic supremacy. But of this I am convinced, the survival of all depends now upon rising above the

terror propaganda and using every moment to build a united strength.

We do know that the grand design of a cooperative peace constructed in the minds of men through the control and development of atomic energy for peaceful use was shattered by the Soviet Union. We do know that the Soviet leaders are following a diabolical design of world domination which they call "liberation." And we do know that the free world possesses potential power roughly twice that of the common enemy.

Our task is to use what time we have to mobilize and coordinate that potential power. If such a mobilization does not prove to be an effective deterrent to aggression, then at least the free world by its collective preparations will be in a better position to resist and ultimately to triumph.

BOOK REVIEWS

An Introduction to Therapeutic Counseling. By E. H. Porter, Jr. Boston. Houghton Mifflin Company. 1950. $2.75.

Carl R. Rogers, in his Foreword to this book, points out that it is, above all, a book which can help the counselor or therapist to *consider*. It helps him to consider, thoughtfully, and with a richness of detail, the issues which arise in counseling and psychotherapy. Recorded interview excerpts, questions, specific examples are the techniques used by Doctor Porter in presenting the vital issues in counseling. What Doctor Porter says is "Here is an issue. Here are ways of thinking about it. Have you considered them all carefully? Have you found a course of behavior which is meaningful to you and in harmony with the basic organization of your own attitude?" — WILLIAM P. SEARS, New York University.

Early Man in the New World. By Kenneth Macgowan. New York. The Macmillan Company, 1950. xv and 260 pages. $5.00.

It was W. W. Howells who said, "Of all animals, we men are the only ones who wonder where we came from and where we go." Teachers are especially aware of the curiosity of children on both of these points. Mr. Macgowan's book will prove of great use to teachers and to older students for it answers many questions about man's dim past. We see ancient man against the background of the great Ice Age. We trace his evolution through his bones and those of the animals of ancient days. We look at his tools and weapons to see if these give a clue to how he lived and what he did. "How old is man in America?" This book tells what the scientists think about this abiding question. — WILLIAM P. SEARS, New York University.

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The Social, Economic *and* Political Implications *of* Atomic Energy

By HOMER D. HIGBEE

Department of Political Science and Public Administration, Michigan State College

THE discovery, use, and subsequent control of atomic energy has, like many another of its technological predecessors, shaken the tap roots of our social structure. It is a re-assertion of the twentieth-century problem of how to fit the social structure to technological advances. Atomic energy has forced the issue with a phenomenal urgency unparalleled in American history. Before we can gather our bearings and plot a successful course for the constructive use of atomic energy we are faced with the problem of whether or not we will use the A-Bomb again as a weapon of war. Under such conditions, the time is particularly propitious for a methodical appraisal of this new giant of our time.

The purpose of this article is to present what seem to be the most urgent aspects of the atomic energy program. A cursory examination of the immediate effects of atomic energy on our social, economic, and political institutions will be followed by a discussion of some possible future implications which may arise from the present administration of this new source of energy. There is in the second category of this discussion fertile seed awaiting the proper season for germination and growth. It is here in particular that we Americans must tend this young plant carefully; it is here that we must observe and mould the growth of this seedling in the direction of fundamental precepts of our political ideology.

It is impossible to separate and categorize the political, economic, and social implications of atomic energy. These closely related aspects of our society demand consideration as a whole rather than as separate parts.

Atomic Energy Act

The Atomic Energy Act of 1946, a bulky document of some fifty pages, presents a sweeping declaration of general policy, establishes an organization to implement this policy, and lays down certain controls for security purposes.

Section 1 states: It is hereby declared to be the policy of the people of the United States *that subject at all times to the paramount objective of assuring the common defense and security,*[1] the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.[2]

Immediately, one discerns the pos-

1 Italics by the author.

2 The Atomic Energy Act of 1946, Public Law 585, 79th Congress, Second session.

sibility of changes affecting our social, economic, and political institutions. The public welfare is to be improved, private enterprise is to be strengthened, and world peace is to be promoted. Note, however, that these are conditioned by an overriding concern for security and national defense. This in itself is not bad *per se*, but subsequent provisions of the Act establish the machinery by which this unprecedented quest for security may become the major purpose of the Act.

Section 2 imposes the responsibility for achieving the stated objectives upon the Atomic Energy Commission. This Commission is composed of five men appointed by the President and confirmed by the Senate. Military officers are ineligible to serve on the Commission.

Standing alone, this Commission is an innocuous appearing administrative body. Clothed with seemingly unlimited powers granted by Congress, it assumes an appearance of far more formidable proportions. A knowledge of its most striking powers is essential for an understanding of possible implications of atomic energy.

Section 3 authorizes the Commission to conduct research and to aid public and private institutions in their research by loans, contracts, and other supporting arrangements. Wide discretion is granted the Commission to perform permissive research functions.

Section 4 makes the Commission sole owner of facilities producing fissionable materials. It is unlawful for any private person to own such facilities. Here develops one of the first major inconsistencies with the basic policy established in Section 1. Congress, in an attempt to reconcile this contradiction, further provided that the Commission may operate its own facilities or it may let contracts to private persons or corporations for the operation of government-owned plants.

Section 5 strengthens Section 4 by granting exclusive ownership of all fissionable materials to private persons or corporations for research, therapeutical uses, or industrial applications upon their being granted a proper license.

The government does not extend its ownership to the ores from which fissionable materials are produced. However, a private owner of such materials must secure a license from the Commission if he desires to transfer or export them from their original source in nature. Congress virtually placed the destiny of future industrial utilization of atomic energy in the hands of this five man Commission by granting it this licensing power.

In the highly important Section 10, Congress deals with the delicate problem of information control. The Commission is delegated the power to determine what kind and how much information concerning fissionable material may be publically communicated. This places the Commission in an unenviable but highly strategic position. As will be pointed out subsequently, section 10 has produced some highly inflammable controversies.

Finally, in Section 11 the most hotly debated economic aspect of the Act, that of patents, is covered. Private patents are prohibited on anything concerning ownership and production of fissionable materials and atomic weapons. Any discovery or invention useful for such purposes must be reported to the Commission.

Certain patents may be issued for discoveries of a non-military nature.

However, the Commission may declare these patents to be affected with the public interest. In such cases the Commission may then license the use of these patents to anyone whom the Commission has previously licensed. Owners of patents are permitted to receive reasonable royalties which may result from an agreement with the licensee. In the absence of such agreement, the Commission will determine the fees.

This constitutes a radically marked departure from our concept of patent rights, particularly in view of the compulsory licensing feature. Time may prove this to be one of the most impregnable barriers to the entrance of private enterprise into the field of atomic energy.

Some Immediate Implications of Atomic Energy

The successful development and initial use of atomic energy resulted from the pressing exigencies of war. Born of war, it has progressed little beyond its initial use. The leaders of our nation, as well as the majority of our people, have to date been uable to extend the scope of their perception of its uses. The maze of security regulations surrounding atomic energy demonstrates extreme concern for the most fundamental of all human desires, security.[3] Maintenance of the secrecy of the process of the bomb has become the omnipresent watchword of our time.

After two years of operation, the Commission was charged with "incredible mismanagement." This charge seems to have started with traces of a political fight, but during the progress of the hearings the question of the Commission's efficiency in enforcing security checks was raised.[4] This, coupled with the simultaneous public announcement that uranium bars had been taken from the Hanford works (Hanford, Washington) without detection by responsible authorities created a pandemonious outbreak of unsubstantiated charges. The issue was kept at fever pitch for a few weeks by the irresponsible comments of public officials to a largely irresponsible press. By innuendo it was charged that the whole atomic energy program was being sold out to Russia by aides of the Commission who could not be trusted.

Though the Commission emerged from this 'ordeal by fire,' it is indicative of the emphasis which has been placed on the atomic energy program. It continues to be primarily a war project. It is our image of the god of war. Lest we lose the image or let it be duplicated by the enemy, we have erected guardian walls watched by untiring sentinels. Only those pure in faith are allowed to attend this deity whose birth was the triumph of the scientific method.

The scientists of the nation have reacted variously to these newly imposed restraints upon their previous free flow of information. They agree almost unanimously that certain essential facts must be kept secret and have imposed upon themselves voluntary censorship regarding such things as basic research toward a possible hydro-

3 See Fifth Semi-Annual Report of the Atomic Energy Commission, Appendix 8, for a resumé of the "Criteria for Determining Eligibility for Personnel Security Clearance."

4 Hearings before The Joint Committee on Atomic Energy, 81st Congress, 1st session. *Investigation into the U. S. Atomic Energy Project*, (23 parts—1256 pages).

gen bomb. There is also a unanimity of agreement that government restrictions on the flow of scientific information is deleterious to the advancement of science. Significant in this respect is the incident of March, 1950, at which time the A.E.C. censored an article written by Dr. Hans A. Beth, former Director of Theoretical Physics at Los Alamos Laboratories. The A.E.C. followed this with an order to all A.E.C. employees and consultants that "until further notice no information on this subject (thermo-nuclear weapons) can be made public by people for the A.E.C. or for contractors on A.E.C. projects."[5] Scientists took a dim view of such action. The general tenor of their attitude was that such censorship discouraged scientists to speak publically or write for general publication on any controversial topic. More and more they will feel it safer to restrict their activities to the laboratory rather than become involved in public affairs. It seems unfortunate indeed to have this one last possible source of information regarding nuclear physics walled in. Especially when the public is so direly in need of such information to aid them in intelligently voicing their considered judgment on atomic public policy.

Industrial Uses

To date atomic energy has not been utilized to any wide extent by private industry. Though there are well-informed men who regard atomic energy as the great new innovator of our civilization, the majority seem to take a less optimistic view. Atomic energy has within it inherent deterrents to effective and economic use. First, it is a highly expensive process to produce plutonium which may now be used as fuel. Second, the cost of the reactor or furnace in which it must be burned runs into prohibitive figures. Third, the radioactive gases resulting from the burning process present a difficult control problem. The cost of each of these aspects of atomic energy as a source of power is likely to impede any progress toward its immediate use for industrial power.

While atomic energy has had no widespread effect on American industry to date, its limited development has been more or less monopolized by a few large corporations. Operating under the pressing needs of war, it is understandable that larger corporations should be called upon to aid the government in developing this new field. Continuation of such policy might, however, be seriously questioned. It may be considered as a violation of the basic public policy which declared, among other things, that free enterprise and competition should be furthered by the Atomic Energy Act.

Affect on Local Governments

Atomic energy has had a more negative than positive effect upon our social institutions. In other words, atomic energy has forced us to think and act in terms of stop-gaps and defensive measures. This reflects a lack of knowledge of its unknown qualities and typically a fear of the unknown.

Since the first military application of the atomic bomb the whole world has taken on aspects of ants whose abode has been smashed by the heel of some careless walker. There has been evidence of that same aimless hurrying and scurrying to nowhere in our

5 Bulletin of Atomic Scientists, May, 1950, "Text of AEC Directives," p. 132.

efforts to appraise the significance of atomic energy.

In general, the public has been left in a penumbra of fear, speculation, and confusion. Only in the past few months have responsible public organizations begun to inform the people, to any extent, about atomic energy. Unfortunately, the information now deemed necessary for the general public is that pertinent to civil defense.

Five years ago there was great hope for some form of international control of atomic weapons. Today that hope is all but gone and the reality of an all-out atomic weapons race between the two great power blocks of the world must be faced. With American troops now locked in combat with the enemy there is no doubt that time has become an inestimable factor in planning against atomic attack.

Measures taken now and in the future to secure the lives of vast numbers of persons residing and working in metropolitan areas will effect a number of changes. The same measures may also determine the future of democratic decentralized government.

Civil defense against atomic attack has taken on an urgency beyond that experienced in World War II. Newspapers relate this to use in stories about the measures taken by individuals to secure themselves and their families. These individual efforts, however, are not sufficient to cope with the situation. We might add parenthetically that they are to no avail unless one's neighbors have been similarly provided for. Studies of devastated areas in World War II magnify the truism that self-preservation surpasses moral considerations. Thus it is necessary for all units of government to plan now for the protection of its inhabitants.

Water supplies, communication systems, transportation, and food supply, all of which are normally taken for granted, may suddenly be destroyed or seriously damaged. Provision for alternate or reserve sources of these necessary items of our complex city life must be made.

Administration of these and other local functions must be included in any emergency plan. Casualties to those experienced in administration of local government would create chaos immediately if alternates have not been trained to replace them.

Local levels of government would seem to be the most logical units to assume these duties. However, our units of government both on the horizontal and vertical plane are so interdependent that planning must be done cooperatively. Will that cooperation be directed by a centralized agency in Washington? Will it be worked out haphazardly by two or three cities in a common area? Or, will it be done on a regional basis?

At the present stage of progress the Federal Government has an office of Civilian Defense. Most State Governments have planned for civilian defense to some extent. The larger cities have also established various types of planning groups for the same purpose. As in other instances, the cities are short-circuiting their lines of communication with the states and are going directly to Washington with appeals for information and money. Does this mean that we may witness a further demise of state and local government in favor of further centralization in Washington?

Possible Future Implications

As has been suggested previously, the public has received little information which would aid them in making competent decisions regarding atomic energy policy. Two major factors are largely responsible for this omission.

First, atomic energy is so highly complex that only a few understand it thoroughly. On the whole, those who do are scientists or perhaps employees of the Commission. It is doubtful that many of our Congressmen who are responsible for public policy fully understand its far-reaching implications. With such a lack of adequate information at the top levels it is understandable that the citizenry is also inadequately informed.

Complexity of the subject has bred apathy to a certain degree at all levels. Although this cannot be substantiated without further research, it seems logical to say that men who do not understand a complex problem many times begin to rationalize and find reasons why they should not understand. The veil of secrecy beclouding atomic energy offers a ready starting-point for such rationalization. It becomes unpatriotic to be too inquisitive. One may become suspect if he tries to learn the secrets of atomic energy. Once patriotism and loyalty have been questioned the individual is open to all the charges of heresy against God and country. In short, it is much easier and more comfortable to remain among the unlettered on atomic energy.

The second factor contributing to a lack of public information is fear. The world has learned to fear the atomic bomb. It has not learned to understand its motivating force, atomic energy. Fear has created a desire to flee from thoughts of potential destruction. A rather typical reaction is observed. Many are covering their eyes with their hands to blot out that which they do not wish to see. Possibly this attitude has been transferred to all aspects of atomic energy including the aspect of accurate information.

The A.E.C. has been charged by scientists at various times for failure to declassify certain information regarding basic research on atomic energy. This type of information, say the scientists, already is universally known among top research men and its dissemination would not weaken national security. On the other hand it would benefit the scientific world in general if this information were more widely known. In addition, a great amount of secrecy regarding the A.E.C. policy creates a situation in which the public is barricaded from sufficient knowledge to form a legitimate opinion on atomic energy policy.

The wisdom of withholding information from the public on an aspect of society as important as atomic energy is seriously questioned. If a democracy is to depend on the considered judgment of its people for policy direction, there must be adequate and accurate information available to them. Intelligent decisions cannot be rendered in a vacuum. They must be based on a reasonable knowledge of the possible alternatives. To date this has been impossible.

In the realm of speculation and conjecture there are some important implications which may arise from a continuation of the present atomic energy policies.

As was indicated earlier the Commission has extremely broad power to make decisions concerning all aspects

of the atomic energy program. The five composing this commission have the power to call the turns which the program will take. Congress did not and could not write into the Atomic Energy Act a definitive set of rules governing such an unknown quantity. Therefore, they delegated to five men practically all policy-making powers in this field. The result is that we have atomic energy policy formed by administrators rather than by legislators, which has in the past been considered the best rule.

The ability and integrity of Commission members is not questioned. On the contrary, it is felt that they have performed in a laudable manner under very trying circumstances. Congress granted authority to establish policy on a scale exceeding that of any other government agency. In addition, the Commission functions behind a veil of security regulations, which renders it especially difficult for the exercise of political control. Extension of this practice of public administration into other phases of government is open to serious question. It could mean government by administrative edict rather than government by law. Loss of public control elsewhere in the past has often resulted in a form of benevolent despotism or tyranny by an oligarchy.

To carry this speculation a little further consider the climatic conditions under which atomic energy has developed and will likely continue to develop for an indeterminate period. Tense international relations have contributed largely to the way atomic energy has been used. With the normal increase in governmental control during periods of national emergencies new precedents could easily become established. This, coupled with the complex subject matter, the fear complex, and the already existing secrecy regulations, could combine to establish a centralization of power previously unknown in this country. It might be suggested that this policy, by gaining more strength during a national emergency, may be the forerunner of a new experience in American government.

Military Control and Civil Liberties

Military vs. civilian control of atomic energy was settled in favor of the latter. Only recently a few lawmakers asked for a revision in the Act which would give the military more control of atomic weapons. They were rebuffed in their first attempted resurgence. As the nation goes on to a complete war footing will they continue to be beaten down on the hustings? If they are not, what changes might be wrought by an atomic energy program governed or highly influenced by the military?

It is suggested that because the military is responsible for national security, because it must be highly disciplined and prepared to make decisions without the luxury of democratic give and take, and because its actions must usually be accompanied by a high degree of secrecy it is fundamentally anomalous to the democratic process. This is not to cast aspersions upon the military or to doubt the loyalty and patriotism of its members. It is merely a recognition of the purpose, nature, and methods of military power. Intensification of security measures during the national emergency will bring with it an increase in military control. This, plus the ubiquitous fear of the A-Bomb and the fact that

the present enemy is Soviet Russia could effect a devastating affront to our civil liberties.

Witch-hunting since the end of World War II has reached a degree which at times alarmed even the more conservative element of the nation. With a complex of factors such as increased reliance on the military for the enforcement of domestic security measures, the understandable fear of the atomic bomb, and the encroachment of Communism the most patriotic citizen may become reluctant to voice a liberal view toward social or international policy. The military, whose first consideration is security, might get jumpy as it did in World War II when it evacuated 112,000 Japanese from the West Coast and imposed martial law upon the Hawaiian Islands. It is possible that they might establish Military Areas around each of the atomic energy plants as well as around certain universities doing experimental work for the A.E.C. Minority racial groups and those who hold liberal social philosophies might readily become suspect. Ordinarily calm and sane citizens motivated by an extraordinary fear could conceivably become informers of their neighbor's temporarily heretical remarks or beliefs. Under such circumstances a form of maligned thought control could create a dangerous suppression of civil liberty.

These possible implications are not raised as mere academic questions. They bear kernels of possibility which merit deep consideration. They deserve the constant observation of both expert and lay citizens. Intelligent observation and constructive criticism are not possible in the absence of reasonable information. To this end we must guard against a complete black-out of information brought about by hysterical fear. Lines of communication must not be captured or closed by default on our part by any person or group in the sacred name of security.

Conclusion

Five years have elapsed since the inauguration of the atomic era. Thus far they have been five years of groping darkened uncertainty. Our most hopeful ray of light has been generated by the atomic scientists who endeavored to make broader knowledge of atomic energy possible. Credit in large measure is due them for their efforts. They have been the eyes and ears of the public during these embryonic years of atomic energy development. We must not overburden them with that duty. We, as educators, are obligated to learn all we can about atomic energy so that information may be passed on to our students and communities. It behooves us to give thought to the implications of atomic energy in order to add our bit to planning for its constructive use.

In a democracy every citizen is obligated to keep himself informed on public affairs. Information about atomic energy and its administration has been enveloped by an aura of almost superstitious incredulity. In these circumstances the average citizen has only a vague impression of the atomic energy program.

During international crisis there may be a tendency of our citizenry to support a more complete blackout of information. Thoughts of constructive

uses of atomic energy will be relegated to a minor role by those who advocate that security is dependent on maintenance of an illusory wall of atomic bombs.

This problem represents another in a series of historical examples which have made necessary a readjustment of societal relationships. Atomic energy has not yet been properly assessed and fitted into its useful role for human advancement. Criticisms made of its present use and administration are intended to be of a constructive nature. Only in this way will atomic energy be accorded its rightful position among other technological and sociological innovations.

Crime on the Labor Front. By Malcolm Johnson. New York. McGraw-Hill Book Company. 1950. $3.50.

This is a sensational exposé of the way in which organized crime operates on the labor front today. The author, Malcolm Johnson, is a Pulitzer Prize winning journalist who has written scores of articles on conditions along New York's water front. Reporter Johnson interviewed hundreds of union members, haunted waterfront saloons, attended union meetings, questioned murder witnesses and did hours of leg work to gather the abundant and damning evidence of labor gangsterism that makes these pages "red hot;" Mr. Johnson points out that unless crime is recognized and scourged by the union members themselves, Congress will be forced to pass increasingly restrictive legislation, which might well destroy the great gains made by labor in the past half century. — WILLIAM P. SEARS, New York University.

Recognizing the far reaching consequences science has for human society, these stimulating texts organize basic subject matter around problem areas having significance for young people in their everyday living.

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Counseling and Discipline. E. G. Williamson and J. D. Foley, New York. McGraw-Hill Book Company, 1949. XII and 386 pages. $3.75

Here is a realistic approach to a vital problem, the problem of handling individuals in high school and in college, whose behavior is such as to be unacceptable or in violation of good taste, mores, customs, policies, and regulations of communities, particularly of educational institutions. The book discusses techniques and methods. The handling of disciplanary cases is cast in the context of counseling methods and approaches. More attention is given to the diagnosis of the individual than is given to the detection and establishment of the facts of misbehavior. Stress is placed upon the modern clinical and experimental studies of deviate behavior. An excellent text for courses in guidance and in mental hygiene.

— WILLIAM P. SEARS

Educational Implications *of the* Atomic Age

By R. WILL BURNETT and HAROLD C. HAND
University of Illinois

IN certain important particulars the controlled release of atomic energy is not different from other scientific developments. It was achieved by the uncommon and rigorous "common sense" that is the scientific method of inquiry. It resulted from an attack upon fundamental problems in nature by hundreds of men working all over the civilized world over an extended period of time.

As fundamental knowledge was wrested from nature and the controlled release of nuclear energy became a reality there followed a chain of developments—still continuing and to continue—that were the technological, engineering, and social derivatives of the basic scientific achievements.

The bomb was but one of these derivatives. Intensified in time of global war, the final search for the controlled release of nuclear energy was focused on the engineering problem of designing a weapon. That weapon, despite its awesomness, is an engineering gadget. It is comparable to the first internal combustion automobile in that both represent merely an early engineering application of certain basic scientific truths. In both cases the specific application is but one in a substantial chain of further technological applications of the same set of scientific findings to an ever widening arena of human activity.

The internal combustion engine released a chain of technological developments that has resulted in highly mobile devices of all sorts. But the chain did not stop with the automobile, the airplane, the Deisel locomotive, the Jeep, and the tank. These in turn required highway networks, meteorological apparatus and know how, better and automatic block signals, radar, complicated machine tools and the like.

And technological developments always have social concomitants. The internal combustion engine not only created a chain reaction of technological developments but produced, as well, vast changes in social processes.

Take agriculture as one limited example. Agriculture became mechanized and farm production, in this country, became less a problem of producing than of how to get rid of the produce. How to adjust our economic structure and concepts so as to take advantage of the possibilities of better living for all, without at the same time destroying certain cherished values such as those of individual choice, freedom from unnecessary governmental controls, and so forth, became problems of moment.

The farmer's increased mobility through the use of his automobile gave him contact with other methods of living, changed his conception of living

standards, and created a new market for thousands of manufacturers.

Concepts of thrift and financing were modified. New problems of resource management were encountered. A powerful political force and lobby were created. New norms and value systems were erected.

In these and in other ways the structure and concept of American democracy were affected and affected deeply. And—in a sense—all because the farmer had a car and a tractor.

Thus the nature and process of education were affected. They were affected not meagerly and niggardly but deeply and basically. For the internal combustion engine had thoroughly affected the entire warp and woof of American life. And education is always an expression of the life of a society as it attempts to induct its youth and to maintain and advance iself.

The Fundamental Task of Education in the Atomic Age

Atomic energy is on the high level of the internal cumbustion engine, the wheel, and the radio in its potential chain reactivity on technology, social processes, and value systems. It is a pervasive new development that has already had tremendous impact on the thinking of man and on the course of his destiny. Many devices and techniques are flowing and will flow from the fount of this basic discovery and its development into useable form. It is thus imperative that educators assess it and understand its present and potential effects on man and his institutions.

This is particularly necessary because of the prodigious power of the atom both for good and for evil. Its constructive possibilities must particularly be emphasized for they are still chiefly a promise unknown to the average man and require general understanding by the people if they are to be realized as fully as possible.

This great new force has been achieved at a time when society is already creaking from the weight of other technological advances that have outstripped its social understanding. At a time when we are beset with numerous proposals and alternatives designed to accommodate society to new technological conditions we now must contend with a new social force so powerful that it must be ranked with the two or three most fundamental discoveries in the history of mankind.

Thus the fact of atomic energy has imperative implications for education. But education has not achieved a full understanding of, nor gained facility in doing, the fundamental job with which it must be charged in a democracy facing an extended period of crisis even though nuclear investigation had never begun.

That task is, *first,* to provide a general undistorted understanding of the changed and changing world so that decisions can be made on the basis of reality rather than myth.

It is, *second,* to stimulate the formation of values that are in consonance with the American concepts of the dignity of the individual, of responsibility, of freedom, and of justice. These values must be formed with reference to the world of reality if they are to be other than merely pious emotional genuflections toward a great tradition slowly dying.

The task is, *third,* to attempt to build some central core of consensus of what is fundamentally good and right in terms of action grounded in

values and realistic with reference to the world as it is. This consensus must be built in local communities, regions, the nation, and internationally.

These, together with the achievement of the more commonly expressed goals of literacy and self-development of the individual, are the tasks of education in a time of continuing crisis. When the impact of atomic energy upon these already heavy tasks is clearly seen the immensity of the responsibility of education in an atomic age will be recognized.

What are the fundamental political, socio-economic, and atomic facts with which the teacher must be familiar in order to understand and carry out his necessary responsibilities today?

Pertinent Facts in the Atomic Age (circa 1950)

The first important fact about the modern world is that it is highly interdependent and, in many connections, apparently inextricably so. Three dimensions of this interdependence will be briefly considered.

First: Modern industrialized nations are economically interdependent. Even the United States, resource-wise the wealthiest of the nations, is not wholly self-sufficient. Mineral deposits, for example, simply do not follow political boundary lines. They are not equitably spaced according to population indices nor teleologically arranged as if nature was given a preview of present political boundaries. Although the United States is extraordinarily rich in most mineral as well as other natural resources, our deposits of manganese, tin, mercury, tungsten, chromium, nickel, and platinum are so inadequate in extent or in quality that we are heavily dependent upon other nations for our supply.

No nation is entirely self-sufficient. No nation has a monopoly on the resources necessary for modern industrial life. Any nation and any people will suffer internally from attempts at self-sufficiency. Such attempts handicap not only the nation making them but also the people of other countries who ordinarily make their living through the exchange of their materials and goods for those produced in the restricting nation and elsewhere.

Despite these facts there are nations which are striving for the maximum of self-sufficiency. These are the dictatorships of various political faiths. The "lebensraum" myths of Hitler were basically designed to achieve the goal of self-sufficiency for the purposes of ultimate world domination. The "liberation" motifs of the neo-fascist Stalin and his Politburo are equally thin disguises of an attempt at self-sufficiency adequate for world enslavement and world hegemony.

Unfortunately there are still Americans who also believe that it is possible for a great nation to insulate itself from the rest of the world—to achieve peace through attempted self-sufficiency militarily and economically. Hoover's recent analysis might just possibly have made some sense in 1900. It makes no sense in 1951 because of the following reasons:

"Backward" (read "have-not") nations are increasingly aware of the distinctions between what they have and what they could have, technically speaking. They fully recognize that free exchanges of goods and resources and technological and financial aids are required for the technically possible to become actuality for them. If

the west forsakes them they will go into the Russian camp.

Such non-communist countries as England require extensive international trade for other than subsistence living. Their proud histories have left a psychological residue that will spell resentment, resignation, and ultimate defeat by the Politburo if they are abandoned by their free neighbors. It is an illusion that America can remain free if totally surrounded by the Russian brand of communism.

Second: Present techniques of communication and transportation have made the world one in the propaganda sense. The forums of the United Nations have facilitated the exchanges of viewpoints among the peoples of the earth, but this is but a recent, if notable, addition to the already overwhelming amount of information and misinformation that has spread from the four corners of the earth to every civilized spot on the earth—except, again, behind the iron curtain of Russia and its satellites and behind the less opaque screens of the lesser dictatorships.

The point is that the world has developed, over the past few decades, a medium of vast power for building reciprocal sympathetic understanding among the peoples of the earth. This same vast power can be used, and is being used, to create distrust, fear, hatred—and war. Very little intelligent effort has ever been made to use these media of mass communication to spread truth, understanding, and sympathetic awareness of the problems of the peoples of the earth.

Even within this country our proper concern over our national security has caused us to tolerate McCarthyism, special "loyalty" (read "conformity") oaths for teachers and scientists, presidential loyalty boards, and has promoted a species of national hysteria in which conformity and secrecy have sometimes been confused with loyalty and security. Real communication and understanding, to say nothing of wise policy decisions, are impossible in such a climate.

Third: Let there be no mistake about it, the world is but one in modern warfare. There are those who still talk of our "mistake" in getting into a "European" war most of us prefer to call World War II. Neither Congress nor President Roosevelt led us into that war. Hitler and fascism did. Our preference for liberty over life did. Our preference to take the chance of total destruction of lives and even country to the continuation of lives and country in concentration camps and in slavery took us into the war. For we could not stay out and remain free. War is total and we had better face up to that reality if we are to survive should war come.

A second basic fact about our modern world is that it is a producing (or at least a potentially producing) giant.

But, as has already been indicated, we have not yet solved our problems of distribution. There is poverty and suffering throughout the world—even internally in the greatest of the "have" nations, including our own.

Let us not blind ourselves to this fact. We have probably done more to erase this ugly picture over the past two decades than any nation on earth. But we still have far to go. So far, in fact, that communistic doctrine and the lies of what Russian communism would do have often fallen on accepting ears.

No one who understands the real

differences between Soviet Russia and the United States today could accept the lies of the communists. So undistorted information on what Russia *does* as distinguished from what she says must be provided.

But it will be far easier for this understanding to be developed in those who have enough to eat, who feel secure, and whose children have clothes, medical care, and education than in those who are embittered, who are cold and hungry, and who have begun to despair of what America really means to them. We must fight communism at its emotional roots as well as at its intellectual level.

One way to do that and to build unity and complete identification with American democracy is to continue to improve both its productive and its distributive power—in material goods and in the essential services such as medical care and education.

We have already alluded to the fact that the "backward" peoples are increasingly aware that there are no good technical reasons for them to remain backward. They increasingly reject colonial status and the connotations of the "white man's burden." The historical record of the west in relation to colonialism and economic exploitation, while not wholly black, is sufficiently streaked with blackness to lend tremendous weight to communist propaganda particularly in South America and Asia.

America cannot hope to lead peoples into a better and freer future by backing the atavistic remnants of all the feudal and colonial past which has been so bleak and opposed to all that America is supposed to stand for.

Real and uncrippled Point Four programs of technical assistance coupled with necessary financial aid and mutual planning are far better propaganda weapons than billions of dollars worth of words—for the former helps remove the cancerous sufferings wherein communism always finds rootage. Democracy is not a product to be sold like a refrigerator. It is something to be experienced, to be savored, to be enjoyed. And the eyes are clearer when the belly is full and the hope for tomorrow is substantial.

The ultimate hope for peace and justice rests on the conviction that modern technology coupled with the world's resources in free exchange are sufficient to provide a decent level of living for all the peoples of the earth. This is not the old shell game and America need not fear its economic degradement. But the citizens of America must learn the facts, see the promise, and do what must be done to make the promise reality.

A third basic fact about the modern world is this! It is a world which, although inextricably interdependent, is peopled with sovereign nation-states and peoples of different backgrounds, histories, experiences, social institutions, forms of governments, values, and moral codes. Thus it is a world of considerable fear, suspicion, distrust, and hatred. It is a world in which provincial attitudes of superiority and proud ignorance of others stand in the way of really cooperative action.

It is a world still committed to unlimited national sovereignty and hence to international lawnessness. It is a world that appears determined to repeat again its mistakes of placing faith in sterile treaties, balances of power, armaments, or disarming. These have never led to peace in the

past. Yet the peoples of the world have not committed themselves to anything superior to these illusory patterns that have never worked in the past.

Yet it is a world that has had considerable experience in international cooperation particularly through the various committees, commissions, and other organized activities of the United Nations. And it is a world in which many nations have learned how peace between member states may be secured through federation and federal law.

A series of advertisements of a year or two ago read: "How American it is to Want Something Better." This irritatingly smug slogan is perfectly valid if the word "American" is changed to "Human." It is because of this fact and because the peoples of the world now know that their lot *can* be bettered that mounting tension in the middle of the twentieth century has brought us close to a third global war. For it is this knowledge that has been utilized by the Hitlers and the Stalins and the Mussolinis and the Francos to establish their vicious regimes.

Thus we have drifted into a situation in which we in the United States are under the obvious necessity of moving as swiftly as possible in the mobilization of our total economy for fighting a war we hope we can win. America, and the world, are fast mobilizing for war. This is the fourth basic fact.

The educational implications of this fact are important and are several. Americans must recognize the imperatives of mobilization and accept the challenge and do their utmost. This requires education. But, in doing this necessary thing, we must be aware of its limitations for continuing peace, even following a war, and we must search for legitimate possibilities that we can, while preparing for a war that may come, still avoid war. This, too, requires education.

It requires education that will produce for the United States a peace objective and a war objective that will reach the minds and souls of men—even behind the iron curtain. An objective so radical in nature, and so sound in conception that it will find a response in the hearts of men all over the world.

It is a safer working hypothesis to assume that the men in the Kremlin are vicious men than to assume their benevolence. But it would be unfortunate to assume that the peoples of the world—even of the Soviet Union—are as a group either stupid or evil. They are just people. And they "want something better." And they want peace.

The radical and wise objective that the peoples of the world will rally round is obviously one that will give real hope for "something better" and for real and enduring peace.

Is such an objective at all possible? We believe that it is. We believe that the idea of world law, representative of the wishes of the peoples of the world and sufficient to maintain the peace, is that objective.

This is the big idea that can reach the hearts, the minds, and the searching souls of mankind—ultimately even beind the iron curtain. This is the radical and realistic idea that the United Nations, through the leadership of the United States, must offer for the consideration of the nations and the peoples of the world.

It is the only idea that is realistic

in terms of our modern world. It is the only thing that will bring a world —already interdependent and one in the physical sense—to a oneness in concepts and practices of freedom, dignity, and secuirty.

If the idea of world law can be institutionalized and made real, then—and only then—can reciprocal and sympathetic understandings of the peoples of the world be generated. It is then—and only then—that backward nations can "safely" be industrialized and the national powers freed from stifling attempts at self-sufficiency and group defense so that they can build a more abundant life for their peoples.

For world law, backed by the overwhelming power of weapons of mass destruction including the atomic bomb, applicable to individuals rather than states, interpreted by world courts, and brought into being through an adequate representation of the peoples of the world, can insure peace and allow the wants of people to be realized.

It is only this that can.

How Has Atomic Energy Affected the World-Picture?

How has the release of atomic energy affected the foregoing general picture and the educational implications of that picture? Other articles in this issue of *Education* have dealt with the promise of the atom to mankind and of the atom as a new weapon of destruction. We will not here repeat what has been said.

It is desirable, however, that we focus what has been said in terms of the world picture we have explored and emphasize those aspects that have peculiarly strong need of educational treatment.

A first fact of importance is that an atomic war could result in brutalization, degradement, and loss of such great numbers of human beings and resources that the complex civilization that we in America and in western Europe are familiar with would have vanished. This fact is fairly generally believed by the informed. Not that it *would* happen, but that it *could* happen. For the first time it *could* happen. Not over night, through push-button operations, but over months or years.

This fact is less important for education than the political and psychological facts that it has created. These must be considered by educators. What are they?

First: Under the illusion held by amazing numbers of American citizens that the United States had a basic secret, or set of secrets, in the atomic bomb, there developed a cerain illusory sense of security that still exists in many places. Our secrets are of an engineering nature. Any country with sufficient scientific and engineering skill and basic resources could develop the bomb. And, of course, we now know that Russia has done just that.

The devil of it is that we wasted time we should have used in building for peace—or, if not that, for war—while lulled with the pleasant fiction that only American genius and know-how could produce the bomb. So we used the time from 1945 to 1950 in dissipating our military potential while, at the same time, neglecting to offer to the peoples of the world really satisfactory inducements toward freedom and peace and away from slavery under communism.

That is spilt milk. But there is

something we must learn from it—and fast! The same people that were saying that Russia couldn't make a bomb are now saying that Russia cannot possibly match us in an atomic armament race.

Poppycock and highly dangerous poppycock! Russia is a ruthless dictatorship. Almost unlimited manpower (even slavepower can create weapons) can be put to work on bomb manufacture. Unlimited natural and human resources can be put to the task.

Let us be realistic. In the long run Russia can probably out-produce America in bomb production precisely because America is free and Russia is slave to the Politburo. (Unless, of course, America mobilizes fully in which instance we, too, go all out for armaments.)

Second: Many peoples, who would probably prefer taking sides with the democracies, are simply not taking sides with either the western powers or the Soviet bloc. Their fear of destruction in atomic warfare makes them seek the illusory position of neutrality. Russia might win without dropping a single bomb because of fear of the bomb. So might we if we do the things we must and in time.

Third: The atomic bomb has created, perhaps for the first time, the possibility that sober men and women of good will all over the world will finally turn away from the pattern of violence toward a determined strategy for peace. This is an outside hope but it is worth considering for its educational implications.

Those shocked by the destructive power of the bomb into apathy or hysteria will not lead the way. Those that naively sign the "Stockholm Peace Petition" without recognizing the farce will not lead the way. And those that whimper that even slavery is better than the flaming violence of a third world war will not lead the way.

But there are increasing numbers who, while ready to fight—and die, if need be to maintain their freedoms, are carefully studying the possible alternatives both to destruction and slavery. These may yet lead the way to ultimate peace *and* freedom for all peoples. And it is the atom that has accelerated this search for a sound strategy for peace.

Fourth: Despite the continuing emphasis on atomic weapons in this country there has been sufficient research under the civilian U. S. Atomic Energy Commission to disclose the tremendous promise of the atom in research, medicine, agriculture, and industry.

In a way this research is creating problems as well as creating opportunities. We already can produce more than we know how to consume nationally. Suppose that we accelerate our productive capacity. Can we adjust to this socially?

Suppose that we materially increase our already aging population through attack on cancer and heart disease—the present chief killers. We are doing just that through atomic research. Will we be able to work out some means of keeping old people busy, productive, happy, and feeling that they are wanted and secure?

Suppose that we some day learn the secret of the green plant. Can we adjust to the assurance that man need never again suffer and die from famine—as 3 millions did in a recent year in India?

As long as we allow the present vast

gap between technical possibility and social actuality to increase, that long will the pressures and tensions continue to build up.

If we can educate ourselves and our children to expect change and to plan for peaceful, orderly, democratic change within the framework of world peace and world advancement, we can look forward with confidence to the new industrial and social revolution the atom is surely bringing.

But if we don't we are in serious trouble even though the present world crisis is abated. For the secret is coming out! The atom can create a bettre world. And the people of the world will demand it. If the United States does not take leadership in making the promise actual for the peoples of the world under peaceful and orderly and free development the communist lies will continue to enslave and to bring chaos to our shores.

Fifth: Under the present crisis situation, there is a set of facts about the atom that has too seldom been explored. It is the most important set of facts for the immediate future, and thus for education, precisely because it offers a possible way in which the United States may develop a strategy for peace that may work. This set of facts is becoming increasingly clear and substantiated and resides in the promise of the atom as a major source of power. Let us examine the possibilities as they now appear.

America has never suffered from the lack of power resources. But not all countries have adequate power access. Both China and India are reported to have but one sixtieth of the per capita power utilization that we have in this country. Furthermore, 70% of their power utilization comes from human and animal muscles. That is quite a difference from the situation in this country. China happens to have considerable coal deposits and economic and technological difficulties have stood in the way of her industrial development.

But there are many backward areas that simply do not have adequate power resources. Could the atom help these countries, virtually all of which are laying plans for industrialization of their economies?

Let us examine the facts as they are presented in two late 1950 publications. One of these is the *Sourcebook on Atomic Energy*.[1] The other is entitled *Economic Aspects of Atomic Power*.[2] Both are authoritative.

Three questions must be answered in the affirmative if atomic power is to find a place in the economics of backward nations seeking industrialization.

First: Is there sufficient uranium, thorium, and protoactinium available in utilizable resources?

Second: Can power reactors be built and operated so as to be economically practicable?

Third: Dare the west make available fissionable materials and technological know-how to nations where atomic power would add materially to their economies when, as is well known,

1 Glasstone, Samuel. *Sourcebook on Atomic Energy*. Van Nostrand, New York. 1950. Written under the direction of the Technical Information Service, Atomic Energy Commission.

2 Schurr, Sam H. and Marschak, Jacob. *Economic Aspects of Atomic Power*. Princeton University Press, Princeton, N. J. 1950. Written under the direction of Schurr and Marschak for the Cowles Commission which was charged with the responsibility of making a thorough exploratory study of the economics of atomic power.

it is but a short step from an atomic reactor to an atomic weapon?

The Sourcebook on Atomic Energy, while dealing only briefly with the question of the economics of atomic power, is one of several authoritative sources that give an affirmative answer to the first question. For—even at our present state of inadequate knowledge concerning utilizable reserves of fissionable material, and the search is just well under way—there are sufficient materials to last the entire world, at its present rate of utilization, and not including the present sources of power, for about one hundred years.[3]

A caution needs to be observed. A nuclear reactor, for power, or for anything else requires a minimum "critical size" to operate at all. Unless "breeder" reactors (which will convert all or most nonfissionable materials produced in the original pile to fissionable materials) work it will be necessary to provide for partial replacement of nonfissionable materials with fissionable ones. But this is definitely practicable and, besides, it looks very like breeder reaction *will* work.

What, then, is the answer to the second question? Can atomic power reactors compete favorably with more conventional power producers? Again the answer is in the affirmative. Because the answer is dependent on certain unknwn factors and depends on estimates regarding these factors it is necessary that we consider the answer cautiously.

Glasstone's analysis has it that the cost of electricity obtained from fission energy will ultimately be likely not to differ greatly in one direction or the other from electricity derived from conventional sources of power.

The Cowles Commission report considered the question at greater length. It pointed out that atomic fuel, as compared with coal or oil is practically weightless. A pound of uranium is approximately equal to *2.5 million pounds* of bituminous coal. *Thus nuclear fuel would tend to equalize the cost of power throughout the world!*

It assumed that the cost of nuclear *fuel* would be very low as compared with conventional fuels. (Present fuel cost comparisons are $20 for uranium as against about $7,500 for an equivalent amount of coal in terms of energy output.)

It must be recognized, however, that the cost of fuel is but one index to the cost of power. Capital outlay, plant construction, and operation costs must be considered.

With all factors considered, including certain necessary estimates, the Cowles Commission offered the following judgments: As compared with electricity produced *at the mine mouth* from coal-burning plants, atomic power would have to be produced at about the lowest estimated costs possible to compete; as compared with electricity produced from coal-burning plants situated about 500 rail miles from the mine in the United States, atomic energy could compete at the intermediate estimated costs of production; *in many countries that must import coal from a distance* (*Brazil and Argentina, for example*) *atomic power could compete with coal-burning plants at the highest cost estimates.*

Our concern, here, has been particularly with such backward countries as are deficient in other sources of power.

3 Op. cit. page 408, par. 14. 131.

It is clear that for such countries, and probably more generally all over the world, the answer to our second question is in the affirmative. This is particularly worth noting because a new and highly promising development may make it possible to reduce iron ore with hydrogen, rather than with coke (which must be obtained from coking coal.) As hydrogen can be produced by electrolysis from water by the use of electricity generated from atomic reactors, many nations such as India and Brazil which have vast iron ore deposits but little coking coal can develop steel industries.

Now it should be understood that, despite the great promise of atomic power, the availability of atomic energy is not the *decisive* factor in the industrialization of the "backward" countries. Necessary as power access is, it in turn rests upon the need for capital and technological know-how.

So our third question is really this: Dare we make atomic power reactors, financing, and technological know-how available to others when we must recognize that atomic reactors can easily be converted into atomic weapons?

This question is a political, not a technical question. Like all such questions it must be answered in terms of political probabilities and from an explicitly seen base of values.

As the writers see it, both our democratic values and a realistic analysis of political probabilities dictate an affirmative answer to our third question. We dare *not*, in fact, answer this question in the negative.

But to answer the question affirmatively, without at the same time providing adequate safeguards against the conversion of these reactors to weapons would be suicidal. Real and continuous inspection of all countries is a requisite and, as Ambassador Austin has indicated in another article in this issue, America has long offered this solution.

But the solution has not been accepted. Fear, distrust, and the awareness of the limitations of control of only one major weapon in preventing war were the chief reasons for the Baruch plan being rejected (we are fully aware that only the Soviet bloc rejected the majority plan.) The Russian plan was, of course, not a plan at all, as Ambassador Austin has made abundantly clear.

Is there, then, no answer? Must we drift into war? Must the atom be used only to destroy or can it help wage the peace? We find but one answer. Some will call it unrealistic. We can find no alternative and thus believe it to be the only realistic answer.

It is for America to issue the call for world law and government of a limited order but sufficient to maintain the peace. Until this comes about the world will lick its wounds, nurse its hatreds, build its potential for destruction, and finally destroy. A world government cannot await a world community of like-minded men. A world community of like-minded men can hardly come about except on the basis of world government that guarantees peace. World government is not the answer to all the world's problems. It is the one answer, as we see it, that will make it possible to attack the world's problems at the fundamental level. If this be true the moral responsibility of education to engage the people of this country in serious consideration of this goal and its many perplexing issues is clear.

We feel that this call, through the United Nations, must come soon. Why? Is it not clear that Russia and her satellites will refuse to be a part of such a world order? Would it not create the very conflict that we are trying to avoid?

As we see it the electric effect of such a proposal—if made through and by the United Nations—would produce a moral suasion of such pervasive power that Russia could not long stay out although she almost certainly would at the beginning.

And if she did stay out she would know exactly where the free world stood and would be faced by effectively and totally organized military power to defeat her. Our international policy has long been a game of diplomatic chess. The Russians move and we attempt to check their move. There is no international law. There is no binding policy or rules under which nations must operate. There is no single statement expressed by the free peoples of the world in concert that this move by any nation-state means immediate, overwhelming military action against it.

Let us spell out our values and moral commitments into law backed up by effective military power and by moral force and justice. Let us open this flood gate of peace so that mankind can benefit from the promise of the atomic age. For world law is the only thing that, in the long run, can bring peace.

And, if it does not bring peace within our time it will, at least, have effectively joined the more productive and more populous free peoples of the earth against the less productive and less populous slave nations. If done now, this ratio of free to slave will be in our favor. If not done in the near future we may lose to Russia through default as we lost China.

Under world law we are very unlikely to have to fight militarily for our way of life. If we do have to fight we are certain to win.

The Educational Implications of this World Picture

One principal generalization emerges from the foregoing analysis. It is this: The crisis which threatens not only the well-being but also the physical existence of the peoples of the nations of the earth can ultimately be resolved only under conditions of effective world law.

It is possible, of course, that this lesson may never be learned by enough people in enough of the dominant national states. Should this prove to be the case, the future of man is indescribably black.

It is most likely, however, that this lesson will be learned, but *not* by conscious efforts to do so. This may come about in either of two ways. Let us note each in turn.

The more frightening likelihood is that it will take one or more additional world wars and/or one or more world-wide economic depressions to teach the peoples resident on this globe that they are, in fact, interdependent, that in such an interdependent world international anarachy will always breed war and human misery, that unlimited national sovereignty or unlimited sovereignty exercised by a partial federation of national states is, in fact, synonymous with international anarchy, and hence that the establishment of effective world law is the basic requisite for peace and decency anywhere on the earth.

The less devastating of these likelihoods is that the hard experiences imposed by the unparalleled defense measures in which the various national states are engaging may teach the lesson which must ultimately be learned. The costs of pursuing military supremacy, though staggering even at the outset, will be ever mounting. Nations will set up economic blockades of potential enemies in the war they are trying to prevent, or to win if it erupts.

The inevitable consequence will be a progressive lowering of the standard of living everywhere, but most markedly in the more powerful "have" nations. Attendant upon all this will be an ever accelerated disruption of all aspects of daily living.

When it is discovered that a few decades or a century of these distressing or devastating experiences but leave the world confronting the ever present threat of an even more horrible war, the futility of continuing to proceed on the basis of present nationalistic assumptions will probably become apparent. Without its exacting curriculum having been consciously designed to do so, this variant of the hard school of experience may, nevertheless, teach the peoples of the earth that only under conditions of effective world law can the nations ever lay down their arms and thus permit the inhabitants of this planet to live decently and abundantly.

What are our citizenship and educational responsibilities in this atomic age of mounting crisis? For us who are leaders in our communities and teachers of youth it is to give the kind of leadership that will result in hard and rigorous thinking on the part of our people, increased awareness of and allegiance to the values of democracy, increased realistic understanding of the nature of the present world and the present crisis, and moral and intellectual commitments to take the forms of action that will represent to the peoples of the world the continuing and deepening vitality of the democratic concept of government by the people, of the people, and for the people.

Such a leadership requires that each of us engage in rigorous thinking and re-thinking in the major dimensions we have suggested for your consideration. Not that you will necessarily come out with the conclusions we have reached. But that, unless you do exercise your democratic responsibilities to think long and hard within a realistic framework of things as they are and as they might be, you are failing your inner self and your fellow man in this country and all over the world.

We have presented an admittedly gloomy view of the possibilities that education can be a sufficiently powerful force to make war, garrison states, and vast economic depressions unnecessary as a core curriculum in the school for survival. The view is only too well justified by present circumstances. But we are compelled to ask, must the pertinent present circumstances necessarily remain what they now are?

The present authors think not. It is their considered judgment that education[4] has to date made but relative-

4 When we speak of education we mean far more than the schools and the colleges. We include *all* of the principal agencies whose business it is to inform and/or to persuade. In the case of the United States this would encompass the press, the radio, the movies, the church, and all of the character building agencies as well as the schools and colleges.

ly little conscious effort to do what it is clearly incumbent upon it to do in reference to the central problem of our age—that of civilized survival in an already closely interdependent world in which atomic energy has been unleashed.

We believe that it is the job of education to help people learn how to live more intelligently—to help them learn to know what they need to know and to do what they need to do in order to live as effectively and happily as possible.

We are convinced that education, even at this late hour, can do much to help mankind weather what seems to us to be the most difficult and hazard-freighted crisis in all recorded history.

The educational job must be done within the framework of a long range view and of a shorter (note that we do not say "short") range view. The long range view must be predicated on the possibility of educating men and women everywhere—enabling them wherever they may be, whatever their color or creed, however exalted or degraded their economic state, to see the way to universal peace and brotherhood under effective world law. The shorter range view must embrace the fact that we in the United States now face the awful possibility of atomic war. Our shorter range program of education must therefore cope realistically with the conditions of hardship, sacrifice, and morale of a people forced to arm thrice in one generation.

Let us, in summary, indicate the appropriate objectives of an education designed to help our people prepare for war physically and ideologically, while achieving the broader goal—real and enduring universal peace.

1. *The American people must understand the basic nature and conditions of the conflict and act accordingly.*

a. They must recognize that at root the struggle is for the minds of men; that it is a struggle between two diametrically opposed ways of life for the allegiances of men everywhere on earth.

i. They must recognize that most of the people who inhabit this planet have for centuries stoically suffered personal indignity, poverty, hunger, and disease, but that these hundreds of millions of men are now rapidly acquiring the belief that they are not fatalistically bound to their fate—that they are acquiring the conviction that something can be done about it. They must recognize that these people are insistently determined to do what they can to alleviate their misery and that Russia offers them a solution.

ii. They must recognize that the communist solution will be accepted by these misery-laden people unless they are offered a solution which is demonstrably better than the Russian solution. They must know that it is precisely this demonstration of the superiority of the free over the totalitarian way of life (in terms of food, clothing, shelter, health, hope for the future, personal dignity and freedom) for the common man that will be the decisive weapon in the conflict.

b. They must recognize that this demonstration of the superiority of the free over the totalitarian way of life will cost the "have" nations of the west, and especially the U.S.A., a lot of money—and that the tax burden will necessarily be heavy.

i. They must realize, however, that they must, at home, practice what they preach if they hope to convince others of the superiority of their way of life;

that America must be well fed, well clothed, well housed, and well educated, and its people in good health and secure in their exercise of civil liberties; that any demonstrated shortcoming in these respects constitutes the weapon the U.S.S.R. most covets.

ii. They must learn the inescapable truth that simply telling Asiatics and Africans about the satisfactions of life in the U.S.A. will not turn the trick. These things must increasingly be experienced by these people if they are to be persuaded. And the United States must expect to help foot the bill.

c. They must recognize that the U.S.S.R. does not propose to extend its domination exclusively, or even chiefly, on the basis of persuasion; that only in the initial phase of its penetration does Russia rely heavily on persuasion; that the U.S.S.R. quickly takes over all the agencies of intellectual, psychological, and physical persuasion and ruthlessly utilizes these to dominate completely the people concerned.

i. They must know that only the retaliatory threat of armed force will prevent armed aggression by the U.S.S.R., and that the free peoples of the west must with all possible speed build up their armed strength to whatever level is requisite to make the threat of retailiatory force an adequate deterrant to the U.S.S.R.

ii. They must know that *no* national state, not even the U.S.A., can alone fortify itself adequately against the threat of Russian imperialism; that to proceed on this assumption is to make it possible for the U.S.S.R. to reduce one by one to vassalage or impotency all the other national states in the world, and finally the U.S.A.

iii. They must realize that the U.S.A. must ally itself with all the other free nations that have the courage to resist Russian imperialism. They must realize that by so doing they run the calculated risk of a world war, but they must understand that this is the only alternative to ultimate vassalage to the U.S.S.R. They can take considerable hope from an appraisal of the present balance of power which indicates that the still free nations make up two thirds of the total population of the world, turn out four fifths of the world's production, and control three fourths of the resources needed for war. They must be brought to see that *if* the free nations stand together communist aggression cannot win.

d. They must recognize that, even under the conditions of an armed partial truce much—and perhaps enough—of a positive, helpful character, can be done to make unlikely the outbreak of total war.

i. Our people must understand the possibilities for the production of power inherent in atomic energy, and support measures designed to make this possible power production a reality in the "have not" parts of the world in order that standards of living may by this means be raised and the attraction of communism thereby dimmed. This recognition and action must be coupled with realistic search for adequate means of controlling the use of atomic reactors so that they cannot be taken over by the enemy or converted to weapons.

ii. They must understand the constructive "sounding board" role played by the United Nations and the constructive work done by its commissions; they must strengthen this instrumentality for the marshalling of

world opinion in support of freedom and decency.

iii. They must understand "how it looks" and "how we look" to the "other fellow"—to all the "other fellows," including the people of the U.S.S.R.—and not assume that the present situation can validly be portrayed in black and white; they must participate in examining the record of what the U.S.A. has done and is doing in order to detect and correct any and all acts of commission and ommission which are at variance with the principles of freedom and decency that we profess; they must see that so to act is not a weakness, but a strength; that only by so acting in fact, can the necessary confidence and good will of the oppressed and depressed peoples be won.

e. They must recognize that the present world crisis will not be of short duration; that, instead, it will in all likelihood extend far into the future; that they must order their expectations accordingly.

2. *The American people must understand, accept, and make effective the defense measures that will prove necessary.*

i. This means that the military establishments must be vastly strengthened, the production figures of World War II will have to be dwarfed, new and radically different provisions must be made for civilian defense against atomic attack. Drastic powers of regulation must be delegated to agencies of government in order to facilitate the building of military strength, the strengthening of production, and the enforcement of necessary measures of civilian defense. It means that the people must understand "why" in order that their sacrifices may be made willingly and unstintingly. It does not mean that the American people should abrogate their rights of free speech, adequate representation in policy formation; nor does it mean that they must be expected blindly to accept "orders" from above.

3. *Our people must recognize that it will take a unified and dedicated people to do what must be done and they must re-dedicate themselves to the ideals of freedom and personal dignity.*

4. *The American people must recognize clearly that every aspect of the national defense must effectively be undergirded by the schools; that only if the schools are strengthened in the performing of their basic functions can the present crisis successfully be survived.*

i. They must recognize that only a highly literate population can field an effective army, navy, and air force; that a people low in literacy can neither make nor use the weapons of modern warfare; that only the schools can produce a highly literate people.

ii. They must recognize that literacy for war or for peace in our technological age includes literacy regarding tools, processes, and natural phenomena; that it includes literacy as to computation and numbers; and that it includes literacy in the several communication skills.

iii. They must understand that the fundamental basis of national unity is laid in the schools and that is in democratic schools that the ideals of freedom, responsibility, and the dignity of man are nurtured and developed.

iv. They must recognize that the foundations of good physical and mental health are laid in childhood and youth; that they must therefore look to the schools if the population is to be tough in mind and body and cap-

able of maintaining its health and safety.

v. They must recognize that only through the education of youths and adults can the population develop the critical understanding of the basic character of the present conflict, or see clearly what must be done, and why, successfully to survive the crisis.

5. *The American people must recognize that we live in a world which science and technology have made so highly interdependent that peace and war, and prosperity and depression, have become geographically indivisible; hence he knows that isolation and unlimited national sovereignty are in reality myths—extremely dangerous myths in that they give us a completely false sense of security and control.*

i. They must learn that all nations, their own included, are nevertheless still clinging tenaciously to the idea and attempted practice of unlimited national sovereignty.

ii. They must learn that history is replete with instances of the generalization that war occurs when non-integrated social units of equal sovereignty clash in reference to their basic interests, and that peace is assured when such units are integrated under a higher sovereignty. They must see that wars between national states can only be resolved under conditions of effective world law in a world federation.

iii. They must learn that there is no body of true world law at the present time and realize, therefore, that a state of international anarchy exists in today's highly interdependent world—a state in which any national state is legally free to do whatever it can of what it wants to do, regardless of the hurtful effects on other nations. They must recognize, further, that unless and until this condition of international anarchy is remedied, continuing world peace is extremely unlikely, if not impossible.

iv. They must recognize, in consequence of these facts, that at least a limited type of world government under effective world law is a necessary condition for peace. They must learn that, given science and technology (especially the atom bomb) and their imperatives, some type of world integration is inevitable—that the only real choice is whether (a) the peoples of the earth will move into an atomic war in which, if any major power survives, some national state or bloc of national states achieves by conquest a slave-type of world integration, or whether (b) the peoples will devote every energy to the progressive achievement of world government through consent.

v. Education must recognize its responsibility to lead people to know and understand each other, to realize that all peoples must be regarded as equally important, that none can be exploited or discriminated against, that no race is innately superior or inferior to any other.

vi. Education must not only provide these understandings but must help people everywhere to implement this understanding by working toward worldwide conditions of justice, eradication of poverty and ignorance, and alleviation of disease and suffering. It must help the people of America and those of the world finally to come to the realization that a deprivation or injury visited upon one anywhere in the world is a deprivation or injury visited upon all.

Emotional Stability *of* Children *in the* Atomic Age

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EMOTIONS arise in situations which the individual feels are emergencies. A person may dislike something that he knows would prove harmful or injurious to him, but not until the danger is actually threatening, does he react emotionally one way or the other. Whether this threatening danger occurs or not, the emergency is present simultaneously with the threat. Protracted periods of continuing crises will produce protracted periods of emotional reaction which gain momentum as the stress continues.

The present atomic age is one of crises, if ever there was such in the history of mankind. Uncertainties increase from day to day. Upon arising in the morning one knows not what may happen by nightfall; upon retiring, one can only guess what world conditions might be by dawn. Perhaps it is well that the average citizen does not take things too seriously, or there would be more emotional breakdowns. Still, it is not wise to stand idly aloof until catastrophe has struck. Rather should one prepare in advance for meeting the situations should they be precipitated.

In the adult world some persons are more stable than others; some can cope with difficult circumstances while others are completely frustrated. The same situation is to be found among children. Some are better equipped emotionally than are others. Then, too, not all the problems of childhood are emotional; neither is all emotion a determinant of problems. It is only when the child is faced with a particular set of circumstances for which he has no adequate response, but instead responds in an ineffectual, disorganized, or socially maladjusted manner, that he has an emotional problem.

By experiencing continued or frequently repeated frustrations and thwartings, the child is more or less in a perpetual state of conflict, terminating in an habitual state of emotional instability. At times there may also be operative a subtle influence of conditioning by which an emotional reaction spreads from one stimulus to another that is fortuitously associated with it. This may start a sort of chain reaction that further complicates the problem of emotional instability for the child.

Emotional disturbances occur in the lives of many individuals, yet there is a vast difference in the degree to which they are experienced by the various persons, and in the variety of forms whereby they reveal themselves outwardly. Some are unable to retain food; others become ill; others, again, lose their former interest and zest. Some persons become very confused about seemingly everything; others

may experience extreme loneliness. Finally, anxieties, fears, and worries seem to occupy all the waking hours of the disturbed individual.

Fundamental to doing anything about the situation is a study of the source or sources of the conflicts. For the purposes of the present brief paper, this might best be done by a study of (1) the main characteristics of emotionality in childhood, (2) the principal factors influencing emotionality, and (3) some means of developing emotional stability.

Characteristics of Emotionality In Childhood

Since the first years of life are of vital importance in the development of the emotions of the child, these must be given a brief survey. Typically the emotions of the very young child are brief. Expressed overtly, they last but a few minutes and end abruptly. As the child grows older, social restraints cause his emotions to be drawn out over a longer period of time and expressed more slowly. Hence occur the childhood moods of sulkiness or bad humor, of timidity, fright, nervousness from repressed fears and anxieties.

The emotions of early childhood are also more frequent and more intense than those of adolescents and adults. After the child has learned that social disapproval or punishment follows emotional outbursts, he begins to try meeting difficult situations by other reactions. The young child's emotions are as intense as they are sudden and brief. By the time he has reached adolescence he knows that such behavior is considered infantile, and he endeavors to restrain his overt responses.

Variability in the emotional responses of children is wide. Shirley and Poyntz (11)* report a study of these differences in the responses of children to health examinations: Some children actively resisted, some tried to withdraw, and others just burst into tears. Johnson (7) found marked differences in emotional responses of nursery school children in fear situations, ranging from caution and timidity to the seeking of help from others.

The emotional states of children can usually be detected by symptoms, for they are not able to hide their feelings so well as adults. In a study of such symptoms, Cummings (2) found a high incidence of symptoms in emotionality. Among the large number of symptoms investigated, excitability, restlessness, timidity, shyness, specific fears, nervous habits, lack of concentration and daydreaming, and anxiety accounted for the highest percentages. It was apparent in the data that generalized anxiety states predominated. Boys were found to have more symptoms of emotionality than were girls.

Factors Influencing Emotionality

Keeping in mind the chief characteristics of emotionality in children, we shall proceed to an analysis of some of the factors operative in causing or further developing undesirable emotional states in children. Basically children's fears are of three kinds: (1) those originating through association with native fears; (2) those that are acquired through imitation of those who are afraid; and (3) those that persist as an aftermath of unpleasant experiences. From this one can readily see how the second and third classes of fears would steadily and rapidly in-

* Figures refer to references at end of article.

crease the emotional instability of children during periods of national and international stress and crises. The present atomic age is not one conducive to the development of emotionally stable children.

In every child the state of emotionality varies from time to time, depending on one or more of a number of factors. A few of the more important of these will be discussed: A common cause of emotionality, especially in the young child is *fatigue*. The child does not recognize fatigue as such and often continues to play actively for too long a time. This coupled with too much excitement and inadequate food will predispose him to increased irritability, temper tantrums, anxieties, etc. The *time of day* may be another factor. Emotionality may be at its height during periods immediately preceding the times for eating, sleeping, or afternoon nap.

Poor Health is another potent factor predisposing a child to emotionality. This may be caused by malnutrition, digestive disturbances, or one or more of any number of physical defects often unnoticed by the adults having the care of the child.

A child's emotionality may often be traced to *parental attitudes*. Cummings (2), mentioned above, found emotional disturbances common among children whose parents neglected them, or who were overanxious about them, or who were away from home a great deal for work or other causes. In Sloman's (12) study more than half the children with emotional problems had compulsive perfectionistic mothers, who would tolerate only the most perfect behavior at all times.

What seems to be the most important all-over factor influencing the emotional stability or instability of the child is his *social environment*. This includes his total social environment, at home, at school, elsewhere. Springer (13), studying a large number of school children of different social levels, found that emotional stability was closely related to the general social status of the individual. Children from a poor social level were more emotionally unstable than were those who came from good, middle-class homes. In their study, Turner and Eyre (14) found grade-placement also a factor in emotional stability of the elementary-school child. The child over-aged for his grade tended to be emotionally unstable; the bright child, much younger than his classmates, tended to develop feelings of insecurity and tensions. Lee (10) made a study of the nursery-school child, and found that environmental conditions also were important at that level. The children were more calm and stable when left to their own pursuits in play activities. The presence of mothers often resulted in emotional instability.

In fine, all factors entering into the child's environment influence in one way or another his emotional development. This includes his activities, the restraints put upon him, the amount of excitement, the type of discipline, and the type of people with whom he is associated. A child who spends much time with others, whether they be children or adults, who are calm and unemotional will soon exhibit similar behavior; whereas the child who must spend considerable time with those who are themselves high strung, nervous, and emotionally unstable will soon develop like traits.

Now if the above factors are influencing the emotionally stability of children in ordinary times, they can

be expected to function to a higher degree in times of stress and continued crises. More fathers and brothers are away from home in the service, more mothers are at work, more families must migrate, there is a shortage of physicians and nurses when the child is ill, food rationing may contribute to malnutrition, and there is a greater tendency for those in the child's environment to exhibit fears, nervousness, worry, and anxiety.

Developing Emotional Stability

In the atomic age with its threat of continuing crises, it is imperative that all who have any contact with children make a conscious effort to assist them in developing an emotional stability that will tide them over impending difficult situations, that will provide them with a background of equilibrium and calmness against the day of increased tensions and possible catastrophe. As Evans and Crary (5) aptly state in a recent article on the continuing challenge to atomic education, "Fear can induce irrational judgments; it can result in a refusal to confront facts; it can impel toward escape in reckless hedonism."

Without stopping to realize what they are doing, adults often contribute to the instability of the child rather than help him to overcome his fears, worries and anxieties, and develop greater stability. Certainly all possible means should be utilized in safeguarding the children in these times of crises. The continual war talk to which the child is exposed, by the radio and television, at the movies, and in the family is threatening the emotional stability of the child.

Educators as well as parents can do much to assist the child in his emotional adjustment. As mentioned earlier in this paper, the child's emotions are largely acquired through imitation and as an aftermath of unpleasant experiences. Herein lies the opportunity for developing stability instead of instability. If the child can learn to be afraid, to be anxious, to worry, and to fear, then he can also learn the proper control of these emotions if the adults with whom he associates, both at home and in the classroom, possess and exhibit good emotional control. Hagman (9) found that preschool children had learned to fear certain situations by observing the mother's fear in those situations. His study proved a real tendency for the child's fears to correspond to those of the mother in a correlation of .667 +.04. More recently Dunbar (3) in a similar study found the mother's emotional attitude reflected in that of the child. Another interesting study showing how the mother's emotional tension affects the very young child has been reported by Escalona (4). Infants were found to refuse the breast if the mother was high strung and nervous; while older babies often violently resisted food if fed under tension, but ate when with a relaxed person.

In an attempt to eliminate fears in children, Jones (8) tried seven or eight different methods, but only two proved successful, namely "direct conditioning" and "social imitation." Using a questionnaire method, Jersild and Holmes (6) inquired of a large number of young mothers what they considered the most effective methods of overcoming fears. The methods most effective included helping the child to acquire skills in dealing with the feared object, providing him with opportunity for knowledge of the

feared object, and leading him gradually into contact with it.

These studies and experiments all point to learning as the most potent tool for developing emotional stability in the child. However, one must not overlook the necessity of giving children adequate care in times of stress and crises. Lack of parental supervision and employment of parents were given as the causes of the increase in juvenile delinquency during the years of the last war. Beals (1) states that "the byproducts of war have more serious effects upon children than the war itself." Speaking for his school in Chicago, he says that serious problem cases for which some solution had to be found came to his office in the following numbers: In the year 1940-1941, 1,862 cases; in the year 1941-1942, 2,367 cases; in the year 1942-1943, 3,553 cases. Of these, the following were sufficiently serious to warrant prosecution: In the year 1940-1941, municipal court, 284; juvenile court, 416; in the year 1941-1942, municipal court, 414; juvenile court, 537; in the year 1942-1943, municipal court, 369; juvenile court, 506. These appalling figures speak for themselves.

Concern for the development of emotionally stable children should be considered a serious obligation on the part of all who have contacts with them. Both the home and the school must cooperate at all times, but more particularly during times of greater stress and crises. All the environment circumstances at such times increase the demands made upon the child; they are directly conducive to emotional instability. Therefore, it is of vital importance that educators recognize the gravity of the problem, and take the necessary steps to hold it at a minimum. Short of this, an injustice is being done the children. What they develop, whether it be emotional stability or emotional instability, will be with them for a life-time.

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I Taught Atomic Energy

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IT'S fun to teach when students meet you at the door in the morn- in order to tell you about an exciting article that they found the night before. When they are anxious for class to start because they want to tell the class about what they've read. When they groan with disappointment and amazement when the bell rings. When a student calls you during summer vacation to ask you excitedly if you have seen the article that just came out. Teaching the exciting and timely story of atomic energy and its implications can do these things. I've experienced it.

Many people in education today feel the urgency for teaching information about the implications of the new era, the Atomic Age; but knotty problems still exist in many schools. Who shall teach this new material? Who is prepared to teach it? Where in the curriculum shall it be taught? What information should be taught? To what extent should there be teaching of the social, political, and moral consequences? What concepts can the students understand? Unfortunately, many still believe that the mysteries of atomic energy are something only the specialists in the field can understand.

A few days ago, a teacher from a European school visited my class. At the close of the period, with incredulity, she rapidly questioned me: "But how old are these boys and girls?" "Can they really understand such a subject?" "Where can they find information that they can read and understand?"

My experience has shown me that if boys and girls are given an opportunity to explore this vital topic, my biggest problem becomes one of trying to keep up with them.

I do not feel that I have definite answers to all these problems and do not propose to attempt to offer the reader a neat solution of them; I shall simply report as objectively as I can my experience in teaching atomic energy to freshman high school students during the past two years.

Where Was It Taught?

The unit "What it means to live in the world with atomic energy," is a part of a Freshman Problems course —a common learnings course which meets two hours a day. The content of this course is made up of those problems common to the freshmen in our school.

Most of the subjects taught in our school are library centered and it is extremely important that every student be able to use all of the resources of the library efficiently. We believe that library skills can be taught more effectively if they are taught at a time when the student feels a definite use for them, rather than in an isolated situation.

Success in many of our high school classes also depends upon the student's ability to plan work with the teacher

and the class; to participate in various kinds of presentations—individual, panel discussions, round table discussions, and upon his ability to work with groups in preparing these discussions. This topic offers excellent opportunity for giving training in these techniques.

Emphasis in this unit was also placed upon: developing the ability to keep and use a good notebook, i.e. skill in taking notes, organizing notes and studying from notes; learning to use common abbreviations, learning to organize materials for written preparations; learning to organize and prepare materials for oral presentations such as the speech outline, use of examples and illustrations, use of visual aid materials; learning effective oral communication as an individual and in group discussions.

To teach these things, we had the problem of choosing a unit for exploration that would have group appeal, that would arouse enough curiosity that the students would be interested and eager to investigate and to seek information about it, that would be current enough that information would not only be found in books but also in periodicals and newspapers, and that would offer a great variety of resource materials. Since our library does not offer enough resource materials in any one topic for fifty freshmen to use at the same time, and since it would be difficult to find a single topic with intense appeal for that many, we chose three topics for exploration which we thought would fit these requirements: "Implications of the Air Age," "The Effect of Movies on American Life," and "Atomic Energy." The group was presented with some of the possibilities offered by each topic and each student was allowed to choose the topic which was most appealing to him. There was a teacher to direct the exploration of each topic. I have had the stimulating experience of exploring the topic of atomic energy with two different groups of students during the past two years.

A Look At The Groups

The groups have been made up of eighteen and twenty students each with approximately the same number of boys and girls in each. The ages ranged from eleven to fourteen, the reading abilities from seventh grade to senior high school with the majority having a reading ability of ninth grade level or above. The I.Q.'s ranged from 110 to some above 160 as measured by the Henmon Nelson Test of Mental Maturity.

All of my first group, with the exception of three, came from University faculty homes or homes of other professions. Thus, the majority had access to a variety of newspapers, magazines, and other materials at home. However, none of the parents of students in this group were specialists in any of the physical sciences or social studies.

My second group had an even representation of professional home backgrounds and backgrounds representing the military, business, and labor. A somewhat larger number in this group did not have access to an unusual amount of reading materials at home. Some members of this group, however, did the most extensive reading in the libraries of both the school and city and wrote to a variety of sources for information.

How We Started Our Study of Atomic Energy

The room was prepared for the first meeting of the group with a display of books, magazine articles and pamphlets about atomic energy from my personal files and the library. A bulletin board of curiosity-arousing pictures and articles was started. The second group also had notebooks prepared by the first group to examine.

After considerable discussion and many suggestions the first group decided to call their unit "Implications of Atomic Energy" and the second group chose "What it Means to Live in the World with Atomic Energy."

The first two hours were spent in a general exchange of information in order to find out what we as a group already knew about atomic energy and what we wanted to know about it.

The role of the teacher during this period was one of stimulating curiosity, of motivating, directing, and appraising; constantly alert to the students' interests, concerns, and opinions; the role of suggesting:

"There is a book in the library, called *'Secret'* that gives an excellent discussion of that with vivid pictures and diagrams."

"We can find lots of information about that in *'Must Destruction be our Destiny'* or from this pamphlet *'Where Will We Hide?'* or from a variety of other sources."

"Yes, it is a fascinating book. Do you know anything about the author? He is a most interesting person. The story as to why he, from all journalists, was selected to report the Bikini Test will give you information about how authoritative his writings are."

"When was that particular information published? Why will we have to be very careful about checking the publication date of much that we read?"

"What facts do you have to support that opinion?"

"Several of the recent periodicals have contained information about the H-Bomb. Do you know how you could find out which magazines these are?"

"Would you get that article and reread it again carefully and see if that is what it really says?"

"Do you know how you could find out which books and magazines in the library have information about the possibility of atomic powered planes?"

"Many pamphlets have been publshed about atomic energy. Where can you find these in the library?"

We listed new words, names and places that we associated with atomic energy.

It was an exciting two hours. It was evident beyond doubt that the students were motivated and most certainly the teacher was enthusiastic about the prospects as to what could be done with such intense interests. At times, it was a problem to keep the students from all talking at once. There was some impatience and frustration because I wouldn't give them complete answers to their questions then—just enough to whet their curiosity more. It was often difficult to keep the exploration moving because the students wanted to stop and discuss the problems that were being suggested right then and there.

Topics brought up ranged from the A-Bomb and H-Bomb to stories of apprehension of spies, possible interplanetary travel, McCarthyism, and stories of fictional science.

We decided, as a class, that we

needed to do more reading about atomic energy before we could plan definitely what we wanted to study about it. We also decided that as we read we would keep five lists: 1. new words; 2. names and places associated with atomic energy; 3. questions that we would like to have answered or more information about; 4. experiments and demonstrations that would help to explain atomic energy; 5. resources that we found.

We planned to spend the next several days exploring the resources of our library and the city libraries; examining magazines, books, and newspapers at home; looking for clues as to places and people that we might write to for information, and looking for pictures and articles to add to the bulletin board.

Each member of the class was asked to buy a copy of *Atomic Energy, the Double Edged Sword of Science,* a resource text unit by R. Will Burnett. This was the only common source of information used by every student.

The Period of Exploration and Supervised Study

It was evident to the group that they now needed help in using the library and its resources. The librarian was asked to come in and explain the general organization of the library, the location of materials, how the books were classified, the card catalog, the use of the common reference books such as the Readers' Guide to Periodical Literature, the encyclopedias, almanacs, and the vertical file of pamphlet materials.

We also took time out during this exploration period to learn how to keep a bibliography, how to survey resource materials for future reference and how to use a book effectively. There was some resistance and objection to keeping a bibliography but much of this disappeared as the students found it a useful reference.

It was soon evident to me that they also needed help in how to read scientific and technical materials. For most of them, this was their first experience in reading material for detailed technical information. They had to be shown that it was necessary to read this kind of information much more slowly and analytically, that it was necessary to have definite concepts of the meaning of the words that they were reading, that many times they would have to read the material several times, that it takes time to analyze and understand scientific diagrams. Great improvement was noted in this type of reading as the unit progressed.

They were often so anxious to show me new finds and to discuss them that they couldn't wait until the class period but would stop me in the halls or wherever they saw me. Some even called me at home. The bulletin board was soon overflowing and they decided that the articles needed organization. Materials were rearranged under such headings as: people in atomic energy, science of the atom, the A-Bomb, the H-bomb, Russia and the bomb, peacetime uses, and control.

During the first part of this exploratory period, as their curiosity was aroused, the students kept coming to me for the answers to their questions —"How did they set the bomb off?" etc. I cautiously refused to answer their questions and kept directing them to resource materials, being careful to follow up to see if they had found the answer to their question. For the first time during the year,

many ignored the closing bell as they worked in the library or with materials in the room. The bell was often a signal to them that they could get together in groups and start discussing and arguing about what they were reading. Diagrams appeared on the board that they were using to explain things to each other. I remember particularly one evening when two of the school's "problem" boys stayed until five o'clock arguing over the merits of the different kinds of periodic tables.

Planning the Unit

A few became so interested in their investigations that they resented being disturbed when the group was called together again in order to make plans for the unit. When we met to check the results of our exploratory period, we listed the new words that they were finding on the board—energy, atom, proton, neutron, deuterium tritium, cyclotron, reactor pile, isotope, radioactivity, energy orbit, fission, fusion, alpha ray, saturation weapon, total warfare—the list totaled more than eighty.

They were aghast at the list. "Do you mean we will have to learn all of those?" At the same time they were excited with anticipation. I suggested eliminating some as being unnecessary at this stage of investigation. I met opposition from someone to every deletion I tried to make. They were already aware that they needed definite understandings for critical reading and exact scientific knowledge. Most had experienced difficulty with the use of dictionary definitions.

How were we to build a glossary with definitions that had meaning to us? The librarian was called in again to help us with this problem. She introduced us to the different sources of definitions: glossaries of books of varying difficulty, the different kinds of dictionaries in the library. She pointed out to us how we could find the scientific definition in Webster's and in Funk and Wagnall, how we could work up from a simple glossary to the more technical definition, how the origin of the words sometimes helps our understanding, where we could find very new words, names of people and places, meanings of symbols and abbreviations.

Names associated with atomic science brought another list almost as long as the word list. We wanted to know more about these people. It was agreed that each person would be responsible for information about two. Again we needed help as to where we could find this type of information. The librarian aided us in getting acquainted with the different biographical references. Knowing how to look for biographical information helped us to find the material wanted in the most efficient way. To make sure that we used the variety of biographical references, we decided to make one of our two choices an early worker in the field and the second choice from the contemporary list.

Just as we finished our list of people that we associated with atomic energy, we were visited by the principal of the laboratory school in Hiroshima and his assistant. How embarrassed we were to realize a few days later that the name of Yukawa was missing from our list. Several worried that our visitors might think that we had omitted it because of racial prejudice. Two decided to write them a letter explaining the omission.

The extreme interest of Mr. Torotaki and Mr. Masuda in what we were doing added to the enthusiasm of the class. Before they left they agreed to answer some of our questions about their experiences in Hiroshima if we would not ask them any questions about politics. The students listened and with bated breath to their explanations given in halting English and they were greatly impressed with their extreme interest in what we were doing and their repetition of "Of course there must be peace." We found the books which they sent to us about Hiroshima, books printed in Hiroshima for the American tourists, most interesting.

And then the listing of their questions. Eighty questions about the science of atomic energy alone! There was lots to be found out, lots to be learned! Would we have time to find answers to all of these questions? Upon examination it was found that many of the questions were closely related and could be combined. It was necessary for me to point out to them at this time that the understanding of some of the questions depended upon other knowledge which would have to be gained first. It was agreed that I was to arrange the questions in a logical sequence. It was also seen that if we were to gain real understandings about the social, political, and moral implications that it would be necessary to master the fundamentals of the science of atomic energy first.

The following is a sample of the questions asked about the science of atomic energy. The questions have been left as they were phrased by the students.

1. What is energy?

2. How does energy differ from power?

3. Why do people want atomic energy, anyway?

4. Why is atomic energy better than other kinds of energy?

5. What is the atomic theory? Dalton's atomic theory?

6. How large are atoms? What do atoms look like? Of what are atoms composed?

7. What is the structure of the atom? What are elements, molecules, compounds?

8. What are electrons? Protons? Neutrons? Deutrons? Positrons? Mesons? Neutrinoes? What is an ultimate particle?

9. What is a nuclear charge?

10. What is an electron shell? Electron orbit? Energy orbit?

11. Why don't the electrons and protons within the nucleus repel each other?

12. Why aren't the electrons drawn into the nucleus?

13. If you can't see atoms, how do they know all this about them?

14. What is nuclear physics?

15. Are the atoms of a solid different from the atoms of a liquid or gas?

16. Just what is atomic energy? Nuclear energy?

17. What does E equals mc^2 mean?

18. What is the periodic chart? How is it organized?

19. What is radioactivity? A radioactive substance? Artificial radioactivity? Transmutation?

20. What elements are naturally radioactive? Why are only some elements radioactive? Where are radioactive materials found?

21. How do elements get to be radioactive? What is half-life?

22. What are isotopes? What are radioactive isotopes? Radioactive tracers? Tagged atoms?

23. What is an electroscope, spintharoscope, spectroscope, Crooke's tube, mass-spectroscope, Geiger counter, interpolator, cyclotron, betatron, Van deGraaf generator, synchrotron, Wilson cloud chamber, oscilloscope?

24. What are alpha, beta, gamma, and x-rays?

25. Why are radioactive materials dangerous?

26. What is atomic fission? Atomic fusion? Nuclear fission? Atom splitting?

27. What elements can be used for atom splitting? What is the difference between U-234, U-235, U-238?

28. Why was it necessary to separate the different kinds of uranium?

29. What is an atomic pile? Atomic reactor? Reactor pile?

30. What does it mean to denature fissionable materials?

31. What is a strategic material? What are the strategic materials necessary to manufacture atomic bombs? Does the U. S. have all of these materials?

32. What is heavy water? Deuterium? Tritium?

33. Why do they say that solar energy is atomic energy?

34. What is meant by critical size?

35. How is an A-bomb set off? Where was the first A-bomb exploded? How many have been exploded and where?

36. How big is an A-bomb? How heavy? Cost? How much U-235 or plutonium?

37. What are the principal effects of an A-bomb? Are the effects of the under-water bombs different?

38. Were the bombs dropped on Nagasaki and Hiroshima the same?

39. Why were the effects of the bomb different in different parts of the bombed areas?

40. How long did the ground stay radioactive in Hiroshima and Nagasaki?

41. What did they find out by the Bikini and Eniwetok tests?

42. What is radiological warfare? Radioactive dust?

43. Where are the A-bomb plants in the United States? Why do they publish maps showing the location of the Atomic energy plants and laboratories?

44. Can we keep the atomic bomb a secret?

45. Can the A-bomb itself be used for anything besides war?

46. Is there any known protection against atomic bombs?

47. Why can't we build defenses against A-bombs?

48. What is an H-bomb? A hydrogen-cobalt bomb? Why are they called fusion bombs? Why will H-bombs be more powerful? Has an H-bomb been built yet?

49. *Look* says one thing about the H-bomb and the book *Hell Bomb* says another. How do you know which one to believe?

50. Why don't we just forget about atomic energy, it has caused so much trouble?

Experiments were suggested to show energy changes in solution and in chemical change, to show molecular structure, the recovery of elements from compounds, the loss of the identity of elements in chemical union, the presence of ions, the presence of positive and negatively charged particles in matter, the nature of the electro-

scope, vacuum tubes, centrifugal force, how addition and subtraction of heat energy changes the state of matter, the effects of radioactive material on a Geiger counter, to demonstrate the chain reaction and the effect of bomb explosions.

Students volunteered to make models of atoms, molecules, a cyclotron, an atomic pile, the chain reaction.

Others planned to make diagrams and charts showing the separation of alpha, beta, and gamma rays; radium disintegration; the manufacture of plutonium; separation of U-235, possible structure of the A-bomb and H-bomb; plans of cities of the future; structure of the betatron, the cyclotron, Geiger counter, synchroton, Van de Graaf generator; comparative difference in explosive power of conventional bombs and the A-bomb and H-bomb. Still others planned maps showing location of strategic materials, of atomic plants and laboratories, of distances from Moscow to strategic U. S. cities. Plans were made for a trip to the University of Illinois betatron.

While all kept a bibliography, one student kept an annotated bibliography.

Notebooks

I suggested at this time that they could make very interesting notebooks of the materials that they were collecting, and that the art teacher could help us design fascinating covers for them. A storm of protest went up: "We hate notebooks!" So I dropped the subject, but it was not long before they were offering to put their articles and pictures on the bulletin board, only if I would promise that they would get them back. Later a delegation came to me and asked me if I minded if they kept notebooks!! I again suggested the help of the art teacher.

His planning with them of their notebook covers was one of the most exciting hours of teaching I have ever observed. They discussed colors—hot, intense colors. Nancy agreed, "But I also think of blue, a very bright, intense blue." She searched the room with her eyes for an example. Finding none she decided "I think I'd call it electric blue. I think it's the fear of atomic energy that I associate it with." She found her blue for her notebook in a metallic paper and accented it with metallic red and orange.

"And the lettering," suggested the art teacher as he printed "atomic energy" in thin italic letters. A storm of protest arose. "No, big, heavy letters; block busters!' '

From the school's "problem boy": "They've got to be wider than high, three dimensional, run back deep."

Ideas for design came fast, atomic structural diagrams, sweping arcs of electron orbits, radioactive rays, showers of electrons, chain reactions, the mushroom cloud, repeated patterns of E equals mc^2, and names of atomic scientists and fission symbols.

Names for their notebooks? "You and the Atom," "The Atom and I," "The Nucleus of Trouble"—a long slender bomb extending down through the heart of an atom. "The Challenge of Atomic Energy," "War or Peace and Prosperity."

The organization of the content represented their own concept of the subject. Many interpreted their ideas into design on division pages.

We Study the Science of Atomic Energy

Equipped with knowledge of the resources of the library, knowing what they wanted to find out, and with lots of ideas to express their knowledge as they found it, they were ready to go to work. Library and supervised study and laboratory periods were scheduled to be interspersed with general class discussions.

They found, at this time, that if they were going to exchange the information that they were finding they needed help in organizing and preparing their materials for presentation.

The reports about the people in atomic science were correlated with the study of atomic science so that the students had the necessary information to understand and appreciate the contributions of each of these people as they were given. For example, they had a concept of radioactivity before hearing of the work of Marie and Pierre Curie.

Early in the study of atomic science, there was a feeling on the part of several of being overwhelmed. This was evident in their remarks before and after class—exaggerations and ridiculous uses of the many new words that were confronting them—"Calm down or I'll fry you with my cyclotron."

There was some danger of the brighter students intimidating the slower ones with their knowledge to the point that they would be afraid to express themselves or afraid that their questions were so simple as to sound ridiculous to others. I continually kept them aware of the fact that the only stupid question was the question that wasn't asked and that our goal was not to show off our knowledge but to help each other understand the fundamentals of this new discovery. My inability to answer some questions gave them courage. It was not long until we had built up a back-log of questions that they could not find answers to and that I could not answer or find suitable information about. We made plans to invite a member of the physics faculty to spend an hour with us at the close of our scientific study to help us with these problems —an hour I'm sure that they will all remember.

Besides developing a fundamental knowledge of atomic science, they learned the importance of checking the publication date, the authenticity of the article, to resolve conflicting information, to recognize sensational writing and propaganda.

History of Atomic Energy

Their exploration of the history of atomic energy through the investigation of the people who made this history gave life and human warmth to the scientific facts they were studying. It became an exciting unfolding of a chain of events, as exciting as the chain reaction itself. The names became individuals and it was gratifying to see these scientists take their place on the students' list of heroes. One parent reported that her daughter had a large picture of Einstein on the wall of her room. There was a display of proud, almost personal, acquaintance with these people as their pictures appeared in the various movies that we saw. There was much excitement among the group when they read in the local papers that Dr. Urey was to visit the campus. They were as enthusiastic over seeing him as the

bobby soxers are over the latest crooner.

They were able to make many satisfying and worthwhile inferences from the knowledge that they gained about the lives and works of these people:

— the importance and influence of a great teacher from their study of Rutherford and his many illustrious students—Becquerel and the Curies.
— The importance of pure research.
— the dependence of applied science and technological developments upon pure research.
— the relationship of one discovery to another.
— the internationalism of science.
— our reliance in the past on European countries for advancement in basic science research.
— that science is an unrelenting search for the truth.
— that knowledge once accepted as fact must often change when exposed to the light of new discovery.
— that scientific discovery is not a monopoly of the United States.
— that many top flight scientists sought political refuge in the U.S. when their freedom to seek the truth was endangered.
— the necessity to keep the supply of scientifically trained people flowing.
— why the knowledge of atomic energy cannot be kept secret.
— the great importance of mathematics.
— that scientists are human with families, interesting hobbies and personalities.

Social, Political, Economic, and Moral Implications of Atomic Energy

At the beginning of the unit the class attitude toward this phase of atomic energy had ranged from apathy to a firm belief that they had no interest whatsoever in these problems. By the time we had finished our study of the science and history of atomic energy, they had done a great deal of reading, and often had brought many of these problems into their science discussions. Although their emphasis had been on material advantages of atomic energy they could not escape the implications of these. They began to become aware of the serious lag between our ability to develop new technological advances and to cope with their social impact. As they expressed their attitudes and opinions about these, areas of disagreement arose. As I questioned the basis of their opinions, they began to see that they did not have adequate information about them. Many of their early opinions showed traditional patterns of thinking, the repetition of well known cliches, the voicing of opinions overheard at home. I have tried to keep a record of many of these statements in their own words.

— Wars are caused by a few people that want to make money and there's nothing we can do about it —why worry?
— After all, we can't control the people in Washington that make the decisions.
— We've got more modern conveniences now than we need—why more?
— Why don't we go ahead and drop the bomb on Russia now while we have a chance and get it over with?
— Why don't we just forget about atomic energy? The destruction it causes isn't worth the peacetime uses.

— After all we can't protect the whole world.
— We should have gone ahead and whipped Russia right after the war when we had the chance. We probably don't have a chance now since she's got A-bombs.
— I don't see why we should get so excited about the A-bomb—after all there are worse things like bacteriological warfare.
— Scientists have always found defenses.
— We need a better intelligence department so that spies can't get our scientific secrets.

To help students find answers to questions which have definite answers is easy in comparison with preparing them to seek wise solutions to problems with no set solution and to problems which require that their solutions change as the situations change.

Here the problem was not as simple as just finding the answers. Here the teacher's role was to help the students identify and clarify their problems. It was not as easy for them to identify them in this area. It was necessary to lead them to see that free discussion alone would not bring sound unbiased solutions, free from emotional desire, wishful thinking and ambition; that their free discussions had to be preceded by much free inquiry; that their free inquiring would not be easy because they would find many conflicting opinions. They had to be given help in how to collect conflicting information, how to analyze and evaluate their information, how to sift their materials critically and separate the sensational, the irresponsible and the false from authentic information. Their knowledge of the history of the development of atomic energy helped them to recognize many sound authorities but now they had to become acquainted with authorities outside the field of science. They needed help in how to draw conclusions from their sifted facts.

But more important still, I think that it was essential to lead them to see that many of their solutions arrived at in this manner would necessarily have to be tentative solutions based on current information, solutions that would necessarily be subject to change as new evidence is gained and as situations change.

During our investigation of the implications of atomic energy we kept two quotations on the board before us:

"Education is preparing to accept responsibility in such a way that we become a valuable member of society."

"I know no safe depository of the ultimate powers of society but the people themselves, and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them but to inform their discretion by education" by Thomas Jefferson. The students were helped to develop the attitude that we need not wait to see what happens but that with a clear understanding of a problem as a basis we can help determine what happens. Efforts were made to develop with them concrete ways to determine what happens to society.

Their problems in this area demanded the development of group procedures: the different kinds and purposes of free discussion, group planning, the panel discussion, round table discussion and methods of working together as total groups and in small groups.

Their interests fell into four areas:

the bomb and its effects; peacetime uses of atomic energy for power plants, engines, radioisotopes as a research tool in medicine, biology, agriculture, and industry; the national and international control of atomic energy; and political implications.

Sample questions and problems which grew out of their reading and discussions were:

1. Why can't we outlaw atomic bombs?
2. How can cities be replanned to make them less vulnerable to A-bomb attacks? What is a ribbon city?
3. Was the U. S. wrong in dropping the bomb on Hiroshima and Nagasaki?
4. What is atomic fuel? How will the cost of atomic fuel compare with the cost of other fuels?
5. What changes in our ways of living are likely to develop with the peacetime uses of atomic energy?
6. What is photosynthesis? What is "ocean farming?"
7. What are the problems in the control of atomic energy?
8. What is the difference between the U.S.A.E.C. and the U.N.A.E.C.?
9. Why do some people think that it is dangerous for the Military to have control of atomic energy?
10. What are the arguments for and against World Government? What would a world government be like? Are there other proposals for the solution to world cooperation?
11. What is a world police force?
12. What was the Lilienthal-Acheson proposal? The Baruch proposal?
13. How may our solutions for the control of atomic energy endanger or alter our democracy?
14. Why do some scientists object to working on atomic energy research?
15. Should private enterprise have greater participation in the development of atomic energy?
16. How will the enforced secrecy of atomic energy research affect scientific progress in this field?
17. What do they mean by "The enforced secrecy of atomic research may kill the goose that laid the golden egg?"
18. What are the ways that we can check on the actions of our representatives?

It was most encouraging to see the group grow in ability to attack problems of this sort through acquiring information, weighing it objectively and reaching conclusions with tolerance for the viewpoints of others.

Testing and Evaluating Results

Testing and evaluating were done by means of: objective testing of the students' knowledge of the energy; objective testing of library knowledge; subjective testing of their knowledge of the social, political, and moral implications of atomic energy; testing their ability to organize their information of the entire field through the preparation of papers such as "What I Have Learned in Atomic Energy" and organization of the content of their notebooks; evaluation of oral reports, demonstrations, group participation, projects, and written work; analysis of bibliographies for content and form; anecdotal records of individual and group reactions; a student opinionnaire given at the end of the year.

I have felt from all of these that the interest was such that every student in both groups, with the exception of one, worked up to capacity; that a satisfactory knowledge of facts was gained by all; that there was more

than the usual amount of creative expression of what they were learning; that every student laid a good foundation for continued growth in library skills, in notebook skills, in planning skills, and showed favorable growth in both written and oral communication skills; that their reading interests were broadened greatly and that most made much improvement in their ability to read technical, scientific information, diagrams, and pictures accurately; that they had learned to read much more critically and analytically.

Standardized test data based upon the entire year's work showed gains of as much as 50 percentiles in the lower range and of as much as 10 percentiles in the higher ranges of percentiles in library study skills. Gains in reading ability ranged from .3 months at the higher reading levels to as much as three years growth for some of these in the lower reading levels. Several showed loss in reading rate but a comparable gain in accuracy.

On the Student Opinionnaire of the course, the Atomic Energy Unit was ranked as one of their favorite units and as one of the units most valuable to them.

The first group was able to give a creditable one hour group discussion of their experiences in this unit for a Summer Education Workshop with only two preparatory meetings consisting of a thirty minute planning period and a one hour practice period.

Free discussion initiated by individuals when they come in to show me new articles that they have found not only show a continued interest but a retention of rather detailed factual knowledge.

Evidence of Student Interest

There was much evidence that student interest went beyond the classroom and continued after the close of the unit. One parent reported, "I bring these kids to school in the morning and I've never heard such conversations—about 'isotropes' and words I've never heard of."

Two students waiting for home rides stopped me, "Mrs. Lindsey, we've been arguing about whether Champaign-Urbana is a strategic area."

During a holiday vacation a student called me, "Mrs. Lindsey, I hate to bother you, but my little brother (age nine) and I have been having a terrible argument. Didn't you tell us that we would probably never be able to see atoms? My brother has an article that says that they have made pictures of atoms with a proton microscope." She later brought a letter headed, "Massachusetts Institute of Technology—Dear Mike:" Mike had written to the author and had received a page long answer verifying the information that he had found and a statement: "Your doubt of what may sound to be an incredible statement shows the characteristics of the making of a good scientist."

The news of the possibility of a hydrogen bomb broke two months after we had completed the first unit. One of the students came in with three newspaper clippings and laid them out on my desk, "Look Mrs. Lindsey, Dr. ———— has changed his mind three times in one week about what we ought to do about the hydrogen bomb."

Last year's group checked constantly on the work of this year's group and

some asked to stay after school and see again the movies we were using. Several have continued their notebooks, one of which received the outstanding award in the Junior High School Division of the Illinois Academy of Science Exhibit. The author of this notebook was considered by many of the faculty to be the school's number one behavior problem.

There were many evidences of change in opinion and social attitudes about atomic energy. There were some interesting differences in the opinions and attitudes of the two groups—differences influenced by the change in the more current articles that the latter group was reading, changes associated with a year of national and international change. They represented changes from the general feeling that war is remote, to the opinion that war is most imminent; from much confidence in the United Nations to quavering confidence in the United Nations: from hope for the possibility of world federation to skepticism of its probability; from a feeling of the superiority of the United States and little fear of Russia to doubt of the strength of the United States and great fear of the immensity and power of Russia; from some tolerance of Russia's attitudes and actions to no tolerance; from a feeling of security due to the possession of the A-bomb, an ultimate decisive weapon, to one of little security—"the A-bomb is not all it was cracked up to be; more evidence of the seeking of protection through wishful thinking that "surely there must be a possible defense if we just make the U. S. strong enough;" less feeling of security based on our geographical location in the mid-west; more interest in the possible implications of the problems of control of atomic energy to our democracy, with interest in its relation to free enterprise, personal freedoms, academic freedoms and freedom of scientific research; change in the emphasis on seeking protection by going underground to complete rejection of this idea, replacing it by discussions of decentralization of cities and industries; and greater interest in plans for civilian defense.

There was much evidence that both groups were growing in problem solving techniques: Increased willingness to check evidence on both sides of a question, of critical reading, of comparison of evidences, of recognition of authoritative resources and of sensational writing and propaganda. Above all, I feel that there was a marked increase in their sense of their responsibility as citizens of this nation and of the world.

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We Studied Atomic Energy

EDITOR'S NOTE: *The preceding article by Mrs. Lindsey described a unit on atomic energy as seen by the teacher. The present article consists of separate statements written by thirteen young people who were members of the Freshman Problems class and who studied the unit on atomic energy that Mrs. Lindsey has described. These students are from the first group which studied the unit a year ago. None are now in Mrs. Lindsey's class.*

Last month, a year after their study of atomic energy, these students were asked to write brief statements on how they felt about their unit. Did they enjoy it? What did they not like about it? Had it been of any benefit to them? More was not suggested for we did not want to put words in their mouths. We explained merely that teachers were interested in knowing what students thought about this new study, told them how their statements were to be used, and indicated that they could sign them or submit them anonymously.

The statements that appear here were prepared by the students on an individual basis at the time they were first called together. They did not have the opportunity to review their study or to have their opinions prejudiced through discussion with others. The statements do not represent the entire group as some were absent from school at the time they were prepared, two of the original group are no longer at the University High School, and three students did not want to prepare statements, pleading lack of time.

The statements are unedited and appear just as the students submitted them, errors and all. Here is what one group of young people have to say about a major unit in atomic energy.

ALTHOUGH not perfect, this course was one of the most interesting and enlightening classes I have ever taken. The interest of the class was so great that hardly an evening went by but what several students stayed until four or five o'clock discussing some of the facts and issues raised in class.

Besides the factual knowledge it provided, this class was useful to me in broadening my interest. At the beginning of the unit I think the rest of the class agreed with me in feeling that the scientific viewpoint was the only phase worth studying. As time wore on, and we actually studied the social, military, moral, and other aspects, we very definitely began to appreciate these elements too. While I still think the science is the *most* important factor, I don't by any means feel that it's the *only* one.

In our studying we ran across several statements to the effect that educating the public as to atomic energy is pitifully neglected. Because of this and the interest of the subject, I think it's too bad that all the children in all the schools can't be exposed to a course like this.

— Jerry Kirk

Since we began our atomic energy unit by discussing what we already knew about the subject, and by raising questions, all of us, no matter how little we knew about it, discovered the scope of the field we were to learn about. After several days of exploration, we pooled our bits of information—and our many queries—into a logical outline for the course.

First, we explored the science of atomic energy. This proved to be a little confusing until we became acquainted with the atomic "jargon" and the men behind it, but then the protons and cyclotrons and geiger counters that had been just words took on new meaning.

When we came to discussions of the atom and its effect and uses for the world, there was a good deal of disagreement. Sometimes we got off the original subject, but in the end those discussions proved most stimulating. We increased our understanding of the problems of controlling the atom, and the United Nations' role in this.

Near the end of the unit, the organization of our notebooks consumed a good deal of time, and, I think, proved worthwhile. They summed up our learning in the unit, and gave us a chance to present our own personal outlook on the atom and its place in our world.

Now that I look back on the unit, I think that it helped me to realize the possibilities of the atom in war, and awakened me to the limitless potentialities of the atom in helping man to increased health, safety, and prosperity. It made me aware of our responsibility to the people of the future in the ways we use this atomic energy.

— Nancy Working

I feel that in choosing the Freshman Problems Atomic Energy unit, I was very lucky. I had my reasons for choosing this unit, true, but there were two other units I might have taken at the time. However, I believe that I got more out of the atomic energy unit than I could have from both of the other two units put together. I believe that it was by far the most profitable unit in the whole course; certainly it was the most interesting.

Atomic energy in the world today is one of the most dreaded and most marveled at discoveries of science, and yet there are many people that do not know a thing about it. Or maybe they do know something about the subject, but not enough to do any intelligent thinking on the subject—just enough to be afraid of the whole topic. I believe that education on this topic is badly needed; certainly atomic energy is not to be regarded with an air of suspicion, for many wonderful things can be done with the use of atoms. This course brought to light many of the things that I had been wondering about and completely enlightened the whole field of atomic energy to me. If the world in general is going to get along with atomic energy on even terms, the public should be enlightened. And what better enlightenment could there be than an education on this topic at school?

— Mike Yohe

The choices were, Atomic Energy, Movies in American Life, and The Air Age. My first impulse was to take the movie unit. Atomic energy seemed much too complicated. Most of my friends had decided on the movies and I thought that that would be pretty interesting. Then I started to think.

I'd been hearing a lot about atomic energy lately. What are isotopes? What makes the A-Bomb so much more powerful than any other bomb? What would happen if we became engaged in atomic warfare? These were some of the questions that popped into my mind. My mind was made up. I changed my check mark to the Atomic Energy column. That is one decision I don't think I'll ever regret.

From the very beginning I knew I was going to enjoy it. At first though, my head was swimming with all the new names, terms and vocabulary that I'd never heard before.

After about three weeks of research, diagrams and class discussion, light began to dawn and at the end of the unit, I was pretty pleased with myself.

Now when I read articles in newspapers and magazines I no longer have so much trouble understanding the scientific terms and I know what some of the famous names are famous for. I also realize what kind of an effect the A-Bomb would have on people if ever used steadily in war, but on the other hand, how wonderfully it could serve man in peace-time.

I can truthfully say that I enjoyed taking Atomic Energy and, as I said before, I don't think I'll ever regret my choice.

— Reina Marilyn Cohn

I think that the unit we had last year on Atomic Energy was very interesting!

To begin with before we started the unit we had our choice of three subjects. If you did not want to take Atomic Energy, you could take one of the other two. This was good for two reasons. First it cut down the size of the group, and secondly, everybody that was in it had chosen it and was interested in it.

Also at the beginning we chose just what the group wanted to study.

There were movies and demonstrations throughout the unit which helped a great deal.

We not only studied what it could do in war but its peace-time uses also. We studied the elements and atoms and how the bomb worked.

Another interesting part was about some of the people that were connected with the atom bomb.

On the whole I think that the unit was very interesting and very worthwhile. Also, I would like to say that if it were not for our teacher, Mrs. Lindsey, we would not have gotten as much out of it. Her interest in the subject had a great deal of influence on the group.

— Ann Boys

I thought that the course was largely beneficial. Although when I started the course I did not expect much out of it, I know feel that I did get a lot out of it. When I entered the unit, I knew nothing of atomic energy, or atoms of any size, shape or form. I now know a lot more than I did about atomic energy. In the Junior Academy of Science in Illinois, I won an outstanding award for a note-book I wrote on the subject.

— John Doe

I thought that the unit on Atomic Energy that we had last year in Freshman Problems was very interesting. In the first place I think it is a very interesting subject and I felt that since not too much is known about it, and most of what is known is very

difficult, I had more of a chance to explore the topic and see what I liked best and what was the most difficult, etc. I found that the part I liked best was about the atomic periodic table and the make-up of the atom and the other elements.

It also wakes you up to see what the atom bomb is able to do and also what could be done with it in peace time. I didn't enjoy the part about the bomb too much, but I did find lots of information on it that I didn't know before. I also read the book "Hiroshima" which I found very interesting.

After taking the course, I pay lots more attention to everything I see and hear about the atom.

I know there are some things about that course that will stick with me forever. I can say that I really enjoyed the course even though that was just a starter and I have lots more to learn.

— Dorothy Garland

I studied Atomic Energy in my Freshman year in high school when I was fourteen. There was so much material being published at that time on atomic energy and the atomic bomb that it greatly aroused my interest. The main trouble I had in understanding this material was with the terms it used. Even with the help of the dictionary, I could not comprehend the material. I also wanted to know more about atomic energy.

The unit we had on atomic energy explained the terms and elaborated on them. It gave us the basic information we needed to understand atomic energy. The way in which this was accomplished was interesting and plain to understand. The material was presented in individual reports, group discussions, and lectures by the teacher.

I was not too interested in the making of the notebooks which we did at the end of the unit because I thought that the material I learned during the course was the information I would remember and be able to refer to.

— Mariann Harper

In Freshman Problems we were offered several choices of subjects. The particular unit I chose was a unit on atomic energy. I had read some material that concerned atomic energy before I took this course. This combined with the steady stream of articles in the local newspapers, aroused my interest. I was also quite interested in the effect of atomic radiation on humans. To have a number of other questions answered I took the course. It proved very interesting due to the clear organization of the material presented and the teacher who instructed us.

After taking the course, I was able to understand more clearly the material in magazines and newspapers which dealt with atomic conflicts. Every student should be offered a chance to take such a course as I did. I believe if I had another opportunity I would take the course over again.

— James Gillespie

I thought that on the whole the Atomic Energy course was pretty good but I think that the scientific parts (structure of the atom, etc) should be completely separated from the non-scientific material (city defenses against atomic attack, etc) so that we could go into more detail. The course was not particularly hard and I think

we could go into more detail than we did even if it involved lengthening the course.

— Bill Becker

I was thirteen years old, a Freshman, when I studied atomic energy. I decided to go into that group because I knew so little about it and I wanted to know what it was all about. We studied the science of atomic energy and the effects and possible uses of it in wartime and peacetime.

I don't think the chemicals elements and that stuff was very worthwhile because we studied it a year ago and I already have forgotten most of it. But it is necessary to know the vocabulary and the essential facts on how the atom works, etc. I liked learning about the effects and potentialities of the atom.

Now when I read magazine and newspaper articles, I understand them unless they're very technical. I feel that it was very worthwhile studying atomic energy since it is so important and our generation will be the ones to decide how we're going to use it—for our betterment or our destruction. I think it is necessary for everybody to learn about it.

(I want it to be anonymous)

I enjoyed the unit very much, but there were several places where I think it could have been improved. We went into the science of it but not very thoroughly. One of the most interesting parts of the unit was when we made and developed atomic energy notebooks. I obtained from many articles and information which I sent for valuable and clear explanations of problems which I had not understood before I studied atomic energy. I think we had a very good teacher and she did a very good job in helping to develop the unit *with us* so we could study what we were most interested in.

— Karlyn Kettelkamp

I think that the course was well taught although quite difficult. I didn't learn much myself because I wasn't interested enough and didn't study enough which is my own fault. However now I wish that I had the chance to take it over. Some of it I found interesting but that wasn't the part that the others wanted to study most.

Nearly everybody studied the scientific part of Atomic Energy the most and my brain just doesn't work that way. I was more interested in the uses of it in War and Peace time.

The course did help me in using the library which I was not very good in before I took Atomic Energy. We had to use a lot of references and lots of different books for information. I believe this was one of the primary purposes and it certainly helped me a lot.

From my own point of view I didn't enjoy the course very much but for people really interested in it I would recommend it highly.

— Carolyn Schultz

The Social Science *of* Atomic Energy: *A* Course Proposal *at the* College Level

By ISRAEL LIGHT

One-time Consultant in the Social Sciences to the U. N. Atomic Energy Commission Group, Secretariat, Lake Success. At present engaged in social science research, Washington, D. C.

As science progresses, the world of men, ideas, and things becomes more complex. In a democracy every individual must be in possession of more and more knowledge in order to contribute more effectively to the collective body and will for purposes of direction in our national and international life. It is obvious that the amount of desirable, or even essential, information necessary for this contribution taxes both time and intelligence in our culture, a culture characterized by extreme specialization and atomization of knowledge.

Although the lives of all of us are shaped from cradle to grave by science and technology and an understanding of their applications and implications is as essential as anything to be found in present college curriculums, only a handful of courses in cultural and social anthropology exposes students fleetingly to the concept of acculturation, while a single chapter in most sociology texts deals with cultural change.

Atomic energy has created a great new force in our lives. Yet, although nine out of ten people are infinitely more concerned with and fearful of the applications and implications of atomic energy than they are with knowing what $E=MC^2$ means, our college courses in physical sciences completely overshadow our limited offerings on the social impact of science and technology.

The Atomic Energy Act of 1946 states that:

"The effect of the use of atomic energy for civilian purposes upon the social, economic, and political structures of today cannot now be determined. It is a field in which unknown factors are involved . . . . It is reasonable to anticipate, however, that tapping this new source of energy will cause profound changes in our present way of life."[1]

The hope that the "unknown factors" would eventually become known was expressed later in the Act:

"(b) Report to Congress—Whenever in its opinion any industrial, commercial, or other nonmilitary use of fissionable material or atomic energy has been sufficiently developed to be of practical value, the Commission shall prepare a report to the President stating all the facts with respect to such use, the Commission's estimate of the social, political, economic, and international effects of such use and the Commission's recommendations for necessary or desirable supplemental legislation."[2]

The big questions are, of course:

1 Atomic Energy Act of 1946, Section 1 (a).
2 *Ibid.*, Section 7 (b).

Who will prepare this "estimate of the social, political, economic, and international effects" of atomic energy, what will these effects be, and how will they be measured? The Ogburns, Sterns, and Harts are few, indeed! And, in a democracy, it is the people who must ultimately form policy that will affect their lives as intimately as will atomic energy.

It is for these reasons, and because we believe that there must be developed a generally informed intelligence regarding the implications of atomic energy, that a comprehensive course dealing with the social science aspects of atomic energy is recommended.

General Education and a Course in the Social Science Aspects of Atomic Energy

More specifically, such a course is believed necessary for the following reasons:

(1) The social impact of science and technology is little appreciated or understood by the general population, despite the fact that people dance their lives to the tunes called by the material aspects of our culture, a culture that is scientifically oriented.

Atomic energy is potentially capable of profoundly influencing our economy and way of life. It must be repeated that most people are much more concerned with the applications and implications of atomic energy than with knowing exactly what $E=MC^2$ means. Beyond an essential minimum knowledge of elementary science in one's academic background it is essential to understand how people use science and why. The social, political, economic, and moral implications of science and technology are of primary concern. The study of the ramifications of atomic energy provides a brilliant opportunity for exploring the processes of social change and for examining closely the concept of cultural change.

(2) Such a study of atomic energy would serve to counter the extreme academic specialization so prevalent in institutions of higher education. The compartmentalization of knowledge is commonly illustrated by the undergraduate "major" who continues graduate work with ever greater concentration. The social sciences may be selected by the student. Further subdivision and refinement extends to a discipline, such as sociology, then a branch such as demography, and finally another breakdown into eugenic or economic demography. This splintering prevails in the other disciplines as well.

The world's problems are all of a piece, and it is desirable, even necessary, that the educated individual be at least aware of the variety and relatedness of factors that shape his problems.

By studying atomic energy at the upper undergraduate or graduate level the student is exposed to an intellectual perspective wider than that usually acquired and is given an opportunity to relate the content of discrete courses accumulated in the first two or three collegiate years. Atomic energy can thus act as a catalytic agent. The necessary comprehensiveness of a course in the social science aspects of atomic energy may be considered a recommendation for its inclusion in a program of general education, since attempts would be made to synthesize and integrate much of Man's vast storehouse of knowledge for easier intellectual digestion.

(3) As a potential citizen and leader in the community, the student can be assisted by a study of atomic energy in the acquisition of a capacity and willingness to appreciate and explore all aspects of an issue which he will be called upon to resolve in exercising the franchise.

(4) The problems created by atomic energy emphasize and require concentration upon basic issues in human relationships—the social impact of science; war and peace; nationalism, internationalism, and world unity; standards of living; security, loyalty, and freedom; and so forth.

(5) The study of atomic energy presents an opportunity to various departments for cooperating and even integrating much material usually offered in isolation. Such an activity could foster greater tolerance of differing points of view and would stimulate intellectual cross-fertilization.

General Emphases in the Proposed Course

It is suggested that this course be offered in the senior year. The student would already have been exposed to at least one or two courses in each of the natural, physical, and social sciences, and would be in a position to relate their content. It is conceivable and even probable that participation in this process of synthesis and integration would lead to a genuine, major intellectual experience. Interpretation and analysis in this course would replace description and narration.

The course should be a cooperative endeavor, organized and presented by the various social science departments operating in careful coordination. Certainly at various points in the course the natural-physical science departments should be asked to contribute. It may prove desirable to have the physical sciences introduce the course with a brief orientation in terms of the theories of matter, "piles," "breeding," engineering problems, and other relavent data.

The course should be placed within the framework of the social impact of science and technology and ought to include the following large areas:

(1) *Technology and Modern Life*—in terms of the ability of Man to control his material and natural environment, the social tensions created by scientific progress, cultural change, etc.;

(2) *The Atomic Bomb*—its development, destructive characteristics, possible refinement in future weapons, effects upon military strategy and diplomacy, etc.;

(3) *The Atomic Energy Act*—the struggle for control between civilian and military authorities, major provisions, work and program of the Atomic Energy Commission, uniqueness of certain provisions, secrecy as related to scientific freedom and public understanding, etc.;

(4) *Economic Utilization*—new and expanded industries, use as a power fuel, comparative costs, implication for location economics, requirements for use in various parts of the world, etc.;

(5) *Medical and Agricultural Utilization*—potentialities of tracer techniques, raising health standards, attacks upon the mystery of photosynthesis and cancer, growth habits of plants and animals, etc.;

(6) *International Control*—analysis of the reports of the United Nations Atomic Energy Commission, Soviet

objections to Western proposals, role of the United Nations, power politics as affected by atomic energy, world government, etc.

The above merely touches major topics and relates to the data on atomic energy. The heart of the course should deal with the potential of this data. The following are representative of basic questions that face the social sciences and which will require analysis in such a course:

Even if the majority plan of the United Nations Atomic Energy Commission were adopted, how logical and stable is an organization that operates on a one-world, pooled-sovereignty principle, while all else in international life is settled on a nationalistic, self-interest basis?

How valid is the assumption that the development of atomic energy as a power fuel will revolutionize the world's economy?[3] What is the status of world-wide use of other, conventional fuels? Is the abundance or lack of fuel the major determinant of the absence or expansion of industrial activity?

To what extent does the inability to forecast changes in society wrought by science and the consequent inability to write precise legislation conflict with the ability of the people in a democracy to govern themselves? Is there a potential danger in a shift from government by law to government by administration, as implied by the delegation of power to boards in the TVA and the Atomic Energy Act?[4]

How are the problems of secrecy, public information, and scientific freedom to be resolved in the "cold war?"[5]

What are some of the social functions and obligations of science?

To what extent would the application of atomic energy affect the growth of underdeveloped areas of the world and how? What are some social consequences of population growth, if, medically and agriculturally, radioactive isotopic tracer techniques help cut disease death rates and furnish additional nutritive foods to the diet of the millions in the Far East? How will world-wide power relations be altered by the industrial development with atomic energy of huge areas such as the U.S.S.R. and China?

Under any eventual international control scheme what criteria could be evolved and how in determining what countries would be permitted to establish atomic energy plants? What kind of "quota system" could be developed in deciding national needs? What are some implications of the relationship between government and the elements of the free enterprise system in the present federal monopoly of atomic energy developments?

Needed References for Such a Course

Since the course would be developed within a framework of social impact, sociologists would have no difficulty in referring to appropriate study materials. The author could make a good case for attention to such volumes as Ogburn's *Social Effects of Aviation*,[6]

3 See the excellent book *Economic Aspects of Atomic Power*, edited by Schurr and Marschak. Princeton University Press, 1950.

4 See the excellent article by Dr. E. B. Stason, "Low and Atomic Energy," *Annals*, Amer. Acad. Pol. & Soc. Sci., 249:89-98 (January, 1947).

5 See the recently published volume *Security, Loyalty, and Science*, published by Cornell University; Harold Lasswell, *National Security and Individual Freedom*, McGraw-Hill, 1950.

6 Boston, Houghton Mifflin Co., 1946. Pp. 755.

Technology and International Relations,[7] *Technological Trends and National Policy,*[8] and Bernal's *The Social Functions of Science,*[9] among others. Study of materials such as these would put the student in an appropriate "frame of mind" in interpreting the ramifications of atomic energy. The historian, psychologist, political scientist, and economist, similarly, would have no trouble in contributing their literature, methodology, and points of view to the clarification of the issues to be found in a study of atomic energy.

It is desirable that students acquaint themselves with some of the basic scientific concepts of nuclear physics. *Explaining the Atom,*[10] and *Atomics for the Millions*[11] are two of the better works that require little or no major science background and that provides a knowledge of the development of the controlled nuclear of atomic energy.

There is an avalanche of information pouring steadily from the presses on all phases of atomic energy in books, newspapers, periodicals, monographs, and pamphlets. Much of this material is of questionable validity, while considerable of it is pure speculation passing as authority.

Five discriminating bibliographies emphasizing the social science aspects of atomic energy are available. They are: *257 Selected, Annotated References on Atomic Energy for Schools and Colleges,*[12] the United Nations *International Bibliography on Atomic Energy*: Political, Social, Economic, and International Aspects;[13] a series of annotated bibliographies issued by the U. S. Office of Education;[14] the monthly atomic energy bibliographical bulletin issued by the library of Congress;[15] and the list of references to be found in Newman and Miller's volume *The Control of Atomic Energy.*[16]

Material on atomic energy in print has approached the flood stage, and such titles as *No Place To Hide, There Will Be No Time, Manual For Survival,* and *Must Destruction Be Our Destiny?* have appropriately been labelled the "literature of doom."[17] These titles reflect the times, no doubt. Yet the "classics" in this field handle the subject with a detachment and objectivity that make them essential for study.[18]

The impact of atomic attack upon human beings is vividly told by a half dozen survivors of the Japanese bombings in John Hersey's *Hiroshima.*[19] The other side of these tragedies is contained in the objective analyses and statistical summaries of *The Effects of Atomic Bombs on Hiroshima and Nagasaki,* a publication of the U. S.

7 Edited by Prof. W. Ogburn, University of Chicago Press, 1949. Pp. 201.
8 TNEC Report, Washington, D. C., Govt. Printing Office, 1937. Pp. 388.
9 London, Routledge & Son Ltd., 1939. Pp. 482.
10 By Selig Hecht. N. Y., Viking Press, 1947. Pp. 205.
11 By M. L. Eidinoff and H. Ruchlis. N. Y., McGraw-Hill, 1947. Pp. 281.
12 By I. Light, Bureau of Publications, Teachers College, Columbia University, 1947.
13 Vol. I. by I. Light and R. Frase. Lake Success, 1949; also 1950 supplement.
14 Prepared by I. Light. Write to Publications Division, Federal Security Agency, Washington 25, D. C.
15 Compiled by Janie Mason. Write to Card Division, Library of Congress, Washington 25, D. C.
16 Compiled by M. Leikind. N. Y., McGraw-Hill, 1948.
17 By Michael Amrine, *New York Times Book Review Section,* Dec. 10, 1950. P. 3.
18 The author has estimated the total price of basic literature, sufficient to make the average citizen an "expert," to be $13.50.
19 Available at various prices, including a Pocket Book edition.

Strategic Bombing Survey.[20] A more recent work constituting "a technical summary of the results to be expected from the detonation of atomic weapons" is the "bible" for civil and military defense people, *The Effects of Atomic Weapons.*[21]

The attempts of the United Nations to set up a plan for the international control of atomic energy are contained in the three major reports submitted by that body's Atomic Energy Commission to the Security Council. They have been reproduced by our State Department. All these facts are also recorded in verbatim speeches, documentary form, or outline analysis, point by point, in two valuable State Department publications. They are *International Control of Atomic Energy: Growth of a Policy* and *International Control of Atomic Energy: Policy at the Crossroads.*[22] Full and complete presentation of the Soviet objections, proposals, and points of view are included. These twin volumes provide both instructor and student with source material as well as expert analysis by international authorities.

Atomic energy is controlled here at home by the Atomic Energy Act. A major satisfactory interpretation of this Act in terms of its social, economic, and political implications appears in *The Control of Atomic Energy* by James Newman and Byron Miller. Both authors assisted in drafting the Act, were familiar with Congressional thinking, had access to considerable testimony, and are lawyers with scientific interests. The possible effects of secrecy upon scientific research are explored. The problem of Government vs. Free Enterprise is outlined by way of interpretation of the patent, invention, and production sections of the Act. The structure of the Atomic Energy Commission is carefully laid out. The volume is made complete by a glossary of terms, an inclusion of the Act itself, a bibliography, and a scientific explanation of nuclear fission.

The Atomic Energy Commission itself reports by law to Congress every six months and publishes its report. Eight have been produced so far and recent issues are based upon a major theme. One of the most valuable is the sixth, *Atomic Energy and the Life Sciences,*[23] dealing with the biological and medical aspects.

In a field where speculation is rife and fraught with over-optimism note must be taken of a recently published volume and referred to earlier in this article. It is *The Economic Aspects of Atomic Power.* While most understandable to the commodity economist, real effort is made to realistically analyze the potential of atomic energy as a power fuel, for example, on a variety of industries both in this country and abroad. It is the only work of its kind and deserves close study for its implications.

Any library of major sources of information on the social science aspects of atomic energy must include the only periodical of its kind in the English language, the *Bulletin of the Atomic Scientists.*[24] Appearing monthly, this

20 Washington, D. C., Govt. Printing Office, 1946. Pp. 46. This is one of a series.
21 Washington, D. C., Govt. Printing Office, 1950. Pp. 456.
22 Publication Numbers 2702 and 3161 respectively, and dated 1947 and 1948. Washington, D. C., Govt. Printing Office.
23 Washington, D. C., Govt. Printing Office, 1949. Pp. 203.
24 Published by the Educational Foundation for Nuclear Science, Inc., The periodical address is 53 W. Jackson Blvd., Chicago 37, Ill.

publication not only presents original articles by world famous scientists but also reproduces wholly or in part various official documents as they come out. Civil defense news, United Nations news, academic freedom, the social responsibility of scientists, dispersal of cities, and atomic energy in medicine are but a few of the subjects dealt with in this admirable magazine.

This generation of students will be the first to live with the changes to be wrought by the developments of atomic energy. Major national and international decisions will be made necessary by it. It is time that the courage of foresight took its place beside the safety of hindsight in dealing with what the editor of this issue has appropriately called "the double-edged sword" of atomic energy. The social science disciplines owe the world that measure of cooperation and integration of knowledge that will make the social impact of science and technology on our lives intelligible and meaningful and that will give us guidance and control for the benefit rather than the destruction of mankind.

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